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U. S. DEPARTMENT OF AGRICULTURE.

4
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FODDER AND FORAGE PLANTS

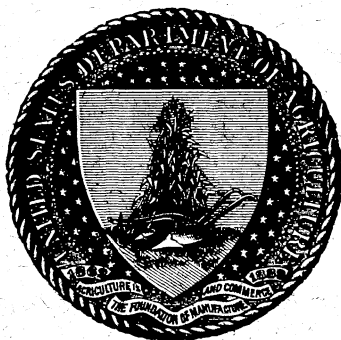
EXCLUSIVE OF THE GRASSES.

BY

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Assistant, Section of Seed and Plant Introduction.

PREPARED UNDER THE DIRECTION OF F. LAMSON-SCRIBNER, AGROSTOLOGIST.



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 1895. Grass Gardens. Exhausted.
 1895. Forage Conditions of the Prairie Region. Exhausted.
 1896. Timothy in the Prairie Region.
 1896. Cowpeas. (Reprinted and published as Farmers' Bulletin No. 89.)
 1897. The Division of Agrostology.
 1897. Lawns and Lawn Making.
 1897. Leguminous Forage Crops.
 1898. Sand-binding Grasses.
 1898. Forage Plants for Cultivation on Alkali Soils.
 1898. Millets. (Reprinted and published as Farmers' Bulletin No. 101.)

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF AGROSTOLOGY,
Washington, D. C., March 28, 1900.

SIR: I have the honor to transmit herewith the manuscript for a second and revised edition of Bulletin No. 2 of this Division, entitled "Fodder and Forage Plants Exclusive of the Grasses," by Mr. Jared G. Smith, formerly Assistant Chief of the Division of Agrostology. Many forage plants little known when the first edition was published in 1896 have since come into prominence, and a number of new ones have been discovered. It is because of the general advance of our knowledge since the first edition was issued that a revised edition of Bulletin No. 2 seems to be necessary, and its publication is respectfully recommended.

The work is popular in its character, and is as free from technicalities as possible. The descriptions are brief, and the remarks under each species include what is regarded as most important, and afford such information as the farmer and others interested would be most likely to wish to know. Besides the cultivated forage plants which are already more or less widely known, native species which have never yet been cultivated are included in the enumeration. There are in the United States over 200 native or wild species of this class which are recognized locally as excellent forage plants. More attention should be given these natives, for there is every reason to believe that among them are many kinds fully equal in productiveness and feeding value to any of those now under cultivation, and possibly many superior to anything we have now in their adaptability to certain soils or climates or in their value for special uses.

It is interesting to note that of the 333 species described 168 belong to the legume or clover family and 30 are salsolaceous plants, or salt-bushes; the former includes alfalfa, the vetches, peas, beans, and clovers, the latter the now well-known Australian saltbush and other plants especially adapted to cultivation on alkali soils.

The bulletin is supplied with an index to the English names by which the various plants are known, the plants being numbered consecutively and arranged alphabetically, thus obviating the necessity of a table of contents.

Respectfully,

F. LAMSON-SCRIBNER,
Chief of Division of Agrostology.

Hon. JAMES WILSON,
Secretary of Agriculture.



ILLUSTRATIONS.

PLATES.

Page.

PLATE I.—Fig. 1, Velvet beans in orange grove in Florida; fig. 2, Soy beans grown in grass garden, U. S. Department of Agriculture, Washington, D. C.	31
II.—Fig. 1, Alfalfa, Belle Fourche, South Dakota, 1897; fig. 2, Hairy vetch, grown in grass garden, U. S. Department of Agriculture, Washington, D. C.	45

FIGURES.

Fig. 1. Gunaninpil (<i>Allionia incarnata</i>)	8
2. Kidney vetch (<i>Anthyllis vulneraria</i>)	9
3. Ground plum (<i>Astragalus crassicaarpus</i>)	11
4. Shad scale (<i>Atriplex canescens</i>)	12
5. Slender saltbush (<i>Atriplex leptocarpa</i>)	13
6. Australian saltbush (<i>Atriplex semibaccata</i>), grown in the grass garden of the Department of Agriculture	15
7. Gram (<i>Cicer arietinum</i>)	21
8. Florida beggarweed (<i>Desmodium tortuosum</i>), grown at the Mississippi Agricultural Experiment Station	26
9. Alfilaria (<i>Erodium cicutarium</i>)	28
10. Winter fat or sweet sage (<i>Eurotia lanata</i>)	29
11. Soy bean (<i>Glycine hispida</i>)	31
12. Sulla (<i>Hedysarum coronarium</i>)	32
13. Black grass (<i>Juncus gerardi</i>)	34
14. Many-leaved vetch (<i>Lathyrus polyphyllus</i>)	37
15. Young plants of Japan clover (<i>Lespedeza striata</i>)	39
16. Dakota vetch (<i>Lotus americanus</i>)	40
17. White Lupine (<i>Lupinus albus</i>)	41
18. Cassava (<i>Manihot aipi</i>)	42
19. Bur clover (<i>Medicago denticulata</i>)	44
20. Black Medick (<i>Medicago lupulina</i>)	44
21. Alfalfa (<i>Medicago sativa</i>)	45
22. Velvet bean (<i>Mucuna utilis</i>), showing leaves, flowers, and young pods.	48
23. Sainfoin (<i>Onobrychis sativa</i>)	49
24. Prickly pear (<i>Opuntia engelmanni</i>)	50
25. Serradella (<i>Ornithopus sativus</i>)	50
26. Ripe pods of the Metcalfe bean (<i>Phaseolus retusus</i>)	52
27. Flower cluster and leaf of the Metcalfe bean	52
28. The fleshy root of the Metcalfe bean	53
29. The Russian blue field pea (<i>Pisum arvense</i>)	53
30. Knotweed (<i>Polygonum aviculare</i>)	54
31. Mesquite bean (<i>Prosopis juliflora</i>)	56
32. Mexican clover (<i>Richardsonia scabra</i>)	58
33. Greasewood (<i>Sarcobatus vermicularis</i>)	59

	Page.
34. Giant spurrey (<i>Spergula maxima</i>)	61
35. Egyptian clover (<i>Trifolium alexandrinum</i>)	62
36. Alsike (<i>Trifolium hybridum</i>)	64
37. Crimson clover (<i>Trifolium incarnatum</i>)	64
38. Mountain Red Clover (<i>Trifolium megacephalum</i>)	65
39. Red clover (<i>Trifolium pratense</i>)	66
40. Buffalo clover (<i>Trifolium reflexum</i>)	67
41. White clover (<i>Trifolium repens</i>)	67
42. American vetch (<i>Vicia americana</i>)	69
43. Giant vetch (<i>Vicia gigantea</i>)	71
44. Spring vetch or tares (<i>Vicia sativa</i>)	72
45. Hairy vetch (<i>Vicia villosa</i>)	74
46. Leaf and pods of the cowpea (<i>Vigna catjang</i>)	76

FODDER AND FORAGE PLANTS EXCLUSIVE OF THE GRASSES.

No. 1. *Abronia latifolia*. Abronia.

A low vine with viscid stems, thick, fleshy leaves, and an enormously thickened, spongy root. Grows on the sand dunes along the coast of Oregon and Washington and furnishes some pasturage for cattle, besides being an excellent sand binder. (Leckenby.)

No. 2. *Achillea millefolium*. Yarrow.

A perennial composite with simple stems, twice pinnately parted leaves, and white or pink flat-topped flower clusters. Common in old fields and meadows throughout the Eastern United States and extending westward through the prairie region. In this country it is usually considered a weed, but in Europe, and especially in England, is held to be a valuable addition to sheep pastures. A favorite feed for sheep in the Cascade Range, found in a great variety of situations, usually in open ground. It is very eagerly sought after by sheep in the spring, but later in the season it becomes dry and less palatable.

No. 3. *Actinella linearifolia*. Tallow Weed.

An annual or biennial wild tansy, occurring in the southern prairie region from central Texas to New Mexico. Valuable for early spring grazing on the ranges. The basal rosette of strap-shaped leaves appears long before the native grasses commence to grow. The bright yellow flowers borne on erect stems 4 to 12 inches high appear from February to April according to the season, at a time when there is no other green feed, and the whole plant is greedily eaten by cattle and sheep. It is said that there is no other arid-land plant which will put so much fat on a sheep's kidneys in so short a time. Tallow weed deserves a thorough trial in cultivation.

No. 4. *Adenostoma sparsifolium*. Deer Brush.

This rosaceous shrub and the closely related *A. fasciculatum* form an important part of the chaparral from the San Bernardino Mountains southward into Lower California. Stock feed upon them in winter and at other times when grass is scarce.

No. 5. *Albizia saman*. Rain Tree.

A leguminous tree, native to Central America and the West Indies. It resembles the mesquite bean, but attains larger dimensions. Like the latter, it produces annual crops of sweet pods, which are eaten by cattle. This tree grows well on arid saline or alkaline soils and would probably do well in southern Arizona and California. The leaves also have some value as forage in time of drought.

No. 6. *Allenrolfea occidentalis*. California Greasewood.

The California greasewood is an erect, diffusely branching shrub, 2 to 5 feet high. It occurs from northern Nevada and Utah to western Texas and southern California. Like the common greasewood, it is one of the characteristic black-

alkali plants. Davy found it growing in the San Joaquin Valley on a heavy, yellowish clay soil containing from 27,320 to 194,760 pounds of total salts per acre-foot. The minimum of alkalies where this plant was growing is more than the greatest amount borne by any of the cereals. Coville found it on the immediate border of an alkaline marsh in the Death Valley, where such alkali-resistant plants as shad scale, saleratus weed, and mesquite bean were located fully 300 yards back from the barren depression at the center of the marsh. This greasewood is grazed to some extent in winter and adds to the value of the pasturage at that season of the year.

No. 7. *Allionia incarnata*. Gunaninpil. (Fig. 1.)

A slender, prostrate plant belonging to the Four O'Clock family, which comes up from the seed after the summer rains in the grazing region of Arizona and New Mexico, and furnishes a palatable and nutritious food for sheep and cattle. It stands pasturing well, and usually ripens an abundance of seed.

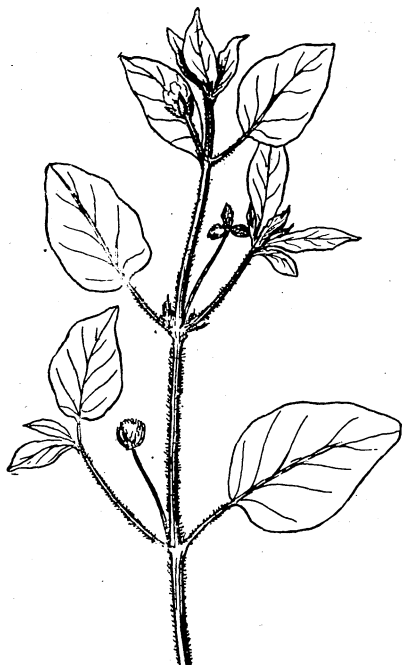


FIG. 1.—Gunaninpil (*Allionia incarnata*).

No. 8. *Amaranthus blitoides*. Rolling Pigweed.

A spreading, branching annual which comes up on newly broken ground, and with other weedy species is readily eaten by cattle before it has become woody. Because of the tumbling of the plants in autumn when they are broken off at the surface of the ground, the seeds are widely scattered by the winds.

No. 9. *Amaranthus palmeri*. Careless Weed.

This erect, leafy annual has a wide distribution through the Southwest. On rich alluvial bottom lands it grows often 5 to 7 feet high, while on the drier mesas and ridges it may be only as many inches tall. Cattle are fond of the leaves and seeds. The amount of seed produced is enormous. Stockmen in New Mexico and Arizona have a high opinion of the careless weed, and often save the bottom-land meadows, where it grows, for winter feed. Sheep may be fattened on the standing careless

weed in winter when there is a shortage of feed on the open range.

No. 10. *Amaranthus retroflexus*. Pigweed.

This well-known annual weed is common in gardens and cornfields in the West. Sheep and cattle relish it, and it often makes valuable feed in midsummer when pastures are dried up, or in the cornfields after the fodder has been cut and the corn husked. It is quite resistant to both alkali and drought. While it is often a decided nuisance in cultivated land, this plant is esteemed a good forage plant by stockmen wherever it occurs on the ranges. It is becoming a common practice in the prairie States to run sheep in the cornfields from about the time the grain is in the milk and the corn has grown to its full height. The sheep clean out the pigweed, purslane, and weedy grasses, and browse the fallen corn blades. The weeds of the cornfields thus supply succulent forage at a time when pastures are dead and brown.

No. 11. *Amblyolepis setigera*. Fall Tallow weed.

A leafy, rank-growing annual, with sweet-scented, bright-yellow flowers appearing in autumn. It grows on the prairies of Texas and Mexico. It is a composite closely related to and somewhat resembling the *Gaillardias*. Cattle and sheep are fond of this plant, especially at the time it is in flower, and fatten quickly in pastures where it is plentiful.

No. 12. *Ambrosia artemisiæfolia*. Ragweed.

This pernicious weed of old fields and waysides has some value as a forage plant.

It is sometimes cut for hay in Virginia.

While stock do not ordinarily graze the plant in pasture as long as there is other feed, horses eat ragweed hay with great relish and apparently do well on it. Analyses of the ash show 9.6 per cent phosphoric acid and 31.1 per cent potash. The fertilizer value of ragweed ash is about \$30 per ton. Another ragweed (*Ambrosia trifida*) is abundant in rich soil in many of the States east of the Rocky Mountains, and is much relished by horses and other stock.

No. 13. *Amphicarpa monoica*. Hog peanut.

A wild bean, native of the woodlands and forests throughout the region east of the Missouri River, with two kinds of flowers; conspicuous ones borne on the upper portions of the plant which seldom ripen seed, and inconspicuous fertile ones borne on slender stalks near the surface of the ground. The latter form fleshy subterranean pods, somewhat like those of the peanut. It is eaten greedily by all kinds of stock, and adds materially to the value of woodland pastures. The underground fruits are eaten by hogs.

No. 14. *Androsace occidentalis*. Shepherd's Purslane.

This low annual, only 1 or 2 inches high, grows abundantly on the ranges in the southwest. At the base there is a thick rosette of short leaves that lie flat on the ground. Each root sends up 10 to 20 short flower stalks bearing umbels of small flowers. Shepherd's purslane comes up through the snow early in March. Sheep eat it as eagerly as they would salt, and fatten where it is at all abundant. The ground is often covered with a close mat of the green leaves. Although the quantity of forage is comparatively insignificant, this plant is highly prized by sheepmen on account of its earliness and abundance.

No. 15. *Anthyllis vulneraria*. Kidney Vetch. (Fig. 2.)

The kidney vetch (fig. 2) is a perennial leguminous plant which is found wild over



Fig. 2.—Kidney Vetch (*Anthyllis vulneraria*): a, flower.

a large part of Europe. It grows naturally along roadsides, wherever the soil is dry and thin and the subsoil calcareous. It was first introduced into cultivation by a German peasant about forty years ago. This farmer noticed that the vetch grew on the dry calcareous soils of hillsides, in places too poor to support even white clover. He gathered a few seeds, sowed them the next year, and kept on sowing them and saving the seed until he had enough to plant quite a large field. From this small beginning the cultivation of the kidney vetch has spread through northern Germany and many foreign countries, and to the United States. In Germany the custom is to sow the seed in autumn at the rate of 18 to 22 pounds per acre, with oats, barley, or other small grain as a nurse crop. Sometimes it is sown alone in the spring. The product of the first year is very small, so that it is only a profitable crop when it is sown with grain, in order that some income may be derived from the land the first season. The second year the vetch throws up large stems often 3 or 4 feet high. The yield of hay is quite small, generally not more than one cutting per season, and perhaps a ton or a ton and a half of hay per cutting. It is cut in full bloom, and cured in about the same way as red clover. Two crops may be secured in one season by cutting the first before the plant blossoms, but usually the aftermath, consisting entirely of root leaves, is grazed and no attempt is made to get more than one crop of hay. Kidney vetch is not recommended for sowing in the United States, except on poor, thin, calcareous or very sandy soils, which are too sterile to support the red or crimson clovers, or any of the better forage crops. It has been tried at a number of the experiment stations throughout the United States, but has been reported as of small value.

No. 16. *Apios tuberosa*. Ground nut.

A wild climbing bean, with milky juice and straight or slightly curved many-seeded pods, growing in low grounds, as far west as the Missouri River. It is eaten by all kinds of stock. The edible tubers, which furnish food for swine, are borne on underground shoots.

No. 17. *Apocynum cannabinum*. Dogbane.

An erect, herbaceous perennial, 2 to 3 feet high, with oblong, opposite leaves. It grows in the humid prairie region. Although this belongs to a family most of the members of which are poisonous, it is reported that the dogbane is eaten by cattle both in pasture and when it occurs in prairie hay.

No. 18. *Arachis hypogea*. Peanut.

An annual legume, native of Peru and Brazil, introduced very widely in cultivation throughout the Southern States. The peanut is hardy as far north as Maryland. This is one of the most valuable fodder plants for the Southern States. There are two varieties—the one which furnishes the peanut of commerce, which requires a long season; and the Spanish peanut, which matures in about three months. The pods of the latter are smaller, and the seeds fewer and smaller, than those of the edible variety. Peanut-vine hay is more nutritious than that of red clover. The yield of nuts ranges from 50 to 75 bushels to the acre. The Spanish peanut is the one usually grown for forage. The vines are pulled when the pods are about half formed, and are converted into hay by a method similar to that used in the treatment of cowpeas. The best commercial nuts yield from 42 to 50 per cent of oil. The cake, after the oil has been extracted, is rich in crude protein and has as high a feeding value as cotton-seed meal. Peanut cultivation has recently increased to a remarkable extent in India and on the west coast of Africa. In 1884 over 700,000 tons were exported from these countries to France for use in the manufacture of oil. On suitable soils the peanut is considered a very profitable crop, and its cultivation might well be extended in the Southern States.

No. 19. *Artemisia cana*. Silvery Sage.

A small shrub, 2 to 3 feet high, with slender branches and long, entire leaves, grayish-white in color. Of the sagebrushes this is the best forage plant. In quality it probably does not differ materially from common sagebrush, but in proportion to area occupied it produces much more forage. It is found chiefly in the alluvial soil on the banks of streams on the foothills and high plains of the West. Its forage value is due to the production each year of a very large number of long, slender, tender shoots, which are browsed in winter.

No. 20. *Artemisia ludoviciana*. Prairie Sagebrush.

A low perennial with lanceolate woolly leaves. It grows on the western plains from Montana and Minnesota to Mexico. Sheep are fond of and fatten on it and cattle browse it during the autumn and winter. Though bitter, the foliage seems to be nutritious.

No. 21. *Artemisia mexicana*. White Sage.

A shrubby perennial, 2 to 5 feet high, with grayish or whitish stems and leaves. The bitter foliage is grazed by sheep and cattle in winter. Grows in the arid districts of the West.

No. 22. *Artemisia spinescens*. Bud Brush.

A much branched perennial, which is found in the arid regions of Wyoming, Utah, and other Western States. It grows to the height of only a few inches from strong, woody, underground parts. It puts forth numerous leafy stems, profusely covered with clusters of yellowish flowers. The large, bud-like clusters of flowers have suggested the common name. It develops early, being at its best by the end of May. It is said that sheep run hastily from clump to clump in search of this succulent morsel.



FIG. 3.—Ground Plum (*Astragalus crassicaarpus*).

No. 23. *Astragalus crassicaarpus*. Ground Plum. (Fig. 3.)

A prairie legume found throughout the Mississippi Valley. It has straggling fleshy stems, narrow leaflets and racemes of purple flowers, and produces every year an enormous number of succulent pods, whence the plant received its name. Sheep and cattle eat both the pods and leaves. In Texas, where the razor-back hog runs at large on the ranges, the ground plum is rapidly becoming extinct, and is only found in pastures protected by hog-proof fencing. The pods, or "plums," are sometimes used as a vegetable. The ground plum appears very early in spring, long before the clovers are ready to use, at a period when rich, succulent food is needed for cows and young stock. If it proves to be adaptable to cultivation, it will be a valuable addition to early spring soiling crops. The pods of the ground plum attain their full size from the last of April in southern Texas to the first of June in North Dakota. They are then succulent and juicy. Later, as the seeds ripen, the pods dry out and by midsummer have become hard, tough, and inedible.

No. 24. *Astragalus nuttallianus*. Texas Pea.

A perennial, like the ground plum in habit and general appearance, but with narrow, curved, bladdery seed-pods on an upright stem. It is abundant in central and northern Texas, preferring the drier ridges and stony hills, while the ground plum grows best in moister valley lands. It is much relished by cattle and is disappearing wherever the ranges have been overstocked. It grows well on cultivated land, increasing in height and amount of seed produced, thus indicating adaptability to improved conditions. The seeds ripen about the 1st of May,

after which the leaves and stems die down and, becoming brittle, are broken to pieces and blown away. On the ranges the Texas pea supplies a large amount of highly nitrogenous forage in early spring, when such feed is most needed. With plenty of rain there is always plenty of grass for summer and autumn grazing. Forage plants that will supply feed before the grass starts are of the greatest possible value to stockmen. The wild peas and vetches ought to be protected from extermination, and more extensively grown.



FIG. 4.—Shad Scale (*Atriplex canescens*): a, fruit; b, flower.

No. 25. *Atriplex canescens*. Shad Scale. (Fig. 4.)

A perennial shrub, often 6 to 10 feet high, rather common on the high plains from Wyoming and Nevada to Arizona and western Texas. The narrow gray-green leaves and young branches are browsed by cattle. The seeds are produced in great abundance, often a peck or more on one plant. These are much sought after by sheep and are considered very fattening. On ranges used as summer pastures for sheep the shad scale can now only be found on rocky cliffs or other spots inaccessible to grazing animals; but

in regions which can only be pastured in winter through lack of water, except that supplied by snowdrifts, the shad scale is found to be increasing from year to year. This is because the stock are necessarily kept off in summer, so that the plant has opportunity to fully recover from the winter grazing and mature its normal crops of seed. Shad scale grows on lands heavily impregnated with white alkali, and also withstands small amounts of the black alkali. It is worthy of cultivation on soils that will not grow grain, alfalfa, or tame grasses. This plant is superior to the shrubby Australian saltbushes, in that it thrives where the winters are quite severe.

No. 26. *Atriplex confertifolia*. Spiny Salt Sage.

A perennial, spreading shrub, with numerous short, thick leaves and spiny branches. It grows 2 or 3 feet high in clumps 4 to 6 or 8 feet in diameter. The leaves and fruits drop off in autumn and are collected in the depressions of the surface or form little wind drifts behind the bushes. These piles of leaves and seeds are the first to be eaten by the sheep and cattle when they enter the winter pastures. The spiny branches are also browsed to the ground. This salt sage is apparently more resistant to strong alkali than almost any of the others, as it often occurs on "greasewood lands" containing a large amount of sal soda. It grows from the Dakotas, Montana, and Idaho southward to Mexico. Spiny salt sage will probably not improve much in cultivation on account of its woody stems, but on moderately strong black alkali lands it is worthy of cultivation for winter forage.

No. 27. *Atriplex halimoides*. Gray Saltbush.

Gray saltbush is a shrubby perennial with something the habit of *A. semibaccata*. The leaves are larger and broader and the whole plant has a whitish appearance. The stems are rather more woody and the plant is more drought resistant. On this account it has proved adapted to conditions in South Africa and probably also would be of value in South America. When not too closely grazed, it ripens seed in great abundance. It would be valuable for trial in Arizona and southern California.

No. 28. *Atriplex holocarpa*. Annual Saltbush.

A low, densely branching annual, less leafy than either of the preceding species, but valuable because of the immense number of round, spongy fruits which it produces. The fruits are from one-fourth to one-half inch in diameter and are readily blown about by the wind, so that if the plant is once established on the range and is not eaten down too closely by stock it will soon become widely distributed. It is one of the saltbushes which is fairly hardy, but is perhaps less drought resistant than many of the perennials. The seeds are not only carried by the wind, but float on the water, and are widely scattered in this way by floods or by the torrential rains to which the arid regions which it inhabits are subjected. Its successful growth in the grass garden on the grounds of the Department of Agriculture indicates that it would be a valuable species to introduce not only on alkaline soils, but also in the grazing regions of the West and Southwest, probably as far north as Colorado and Utah.

No. 29. *Atriplex leptocarpa*. Slender Saltbush. (Fig. 5.)

A perennial, with procumbent stems from 1½ to 2 feet or more in length. It resembles *A. semibaccata* in many particulars, though the plants are smaller and produce less of forage. It is more widely distributed in Australia, occurring in western Queensland and New South Wales and in South Australia along the



FIG. 5.—Slender Saltbush (*Atriplex leptocarpa*).

Murray River, sometimes carpeting the ground over considerable areas. Von Mueller says that its drought-enduring qualities are remarkable. It is particularly relished by sheep, which browse it down so closely that large tracts of it are often entirely destroyed. The seeds are smaller than those of *A. semibaccata*, somewhat cylindrical in shape, two pointed at the apex, and slightly swollen at the middle. They are produced in great abundance and germinate readily under ordinary conditions. This species has been tried in California and in the grass garden on the grounds of the Department of Agriculture, and a small quantity of seed has been distributed to a number of farmers in the West. It is about equally hardy, as regards cold, as *A. semibaccata*, but will perhaps withstand a greater degree of heat.

No. 30. *Atriplex nummularia*. Round-leaf Saltbush.

A perennial shrub, 6 to 10 feet high; the leaves and stems are covered with whitish down, and the broad, fleshy leaves are produced in great abundance. The plant is dioecious, producing male flowers on one plant and female flowers on another. It will grow on soils more heavily impregnated with alkali than *A. semibaccata*, and will also withstand droughts better, but is less hardy. It is extensively planted and highly valued in central Australia and South Africa. In habit of growth and appearance it resembles the native shad scale of the Rocky Mountain region. It is only adapted to cultivation in the warmest portions of the Southwest and might well be grown more extensively in southern California and Arizona. If rooted cuttings are planted over the range immediately following heavy rains, when the soil is wet enough to fairly start the plants, it will undoubtedly become a valuable addition to the range forage. This saltbush produces a great amount of seed in the driest seasons, resembling in this characteristic most native desert plants. The seeds germinate readily when sown on moist soils. According to analyses the round-leafed saltbush will take up more soda salts than will *A. semibaccata*.

No. 31. *Atriplex nuttallii*. Nuttall's Salt Sage.

Nuttall's salt sage is the most common salt sage of the plains of northern Colorado, Wyoming, Montana, and northern Nevada, and is considered by stockmen the most valuable of that region. It is a low, leafy shrub seldom more than 2 or 3 feet high, and, like the shad scale, is perennial. It grows where the soil is dry and so strongly impregnated with alkali that little else will thrive except rabbit brush and bitter sages. It is one of the best of the wild forage plants for winter pasturage. Nelson states that the leaves and young twigs, and especially the seeds, are very fattening, and that sheep eat the forage both green and when it has cured upon the ground. The plant endures much severe trampling and hard usage. In the Red Desert of Wyoming it supplies fully one-half of the winter grazing. Nuttall's salt sage is worthy of introduction into cultivation along with the Australian saltbushes, and wherever it now occurs on the range care should be taken not to exterminate it.

No. 32. *Atriplex pabularis*. Nelson's Saltbush.

A rapidly growing perennial which puts out a great many stems from the roots each year, so that it would have the value of an annual in cultivation. It has only been collected in the Red Desert of Wyoming, on saline flats along the creeks and in the dry beds of alkali basins. Cattle and sheep relish the herbage, grazing it down to the ground each year. It is one of the most promising of the wild saltbushes for cultivation on strongly alkaline soils for winter and summer pasturage.

No. 33. *Atriplex polycarpa*. Scrub Saltbush.

Scrub saltbush is one of the shrubby saltbushes of California investigated by Davy. It was found growing on gravelly soil containing a maximum of 78,000 pounds

of salts per acre-foot, considerably more than the Australian saltbush will stand. There are fourteen or fifteen other species of *Atriplex* in California, mostly confined to the arid alkaline valley lands and the seashore. Many of these contribute to the forage of the region and add value to both winter and summer ranges. Besides these and other closely related shrubby saltbushes there are a number of annuals which are fully as valuable as any of the introduced ones, either in feeding value, amount of seed production, or resistance to and tolerance of injurious soda salts.

No. 34. *Atriplex semibaccata*. Australian Saltbush. (Fig. 6.)

Australian saltbush is a much-branched perennial, which forms a thick mat over the ground a foot thick. The branches extend from 6 to 8 or 10 feet, so that one plant will often cover an area 20 feet in diameter. The leaves are about an inch long, broadest at the apex, and coarsely toothed along the margin. They are fleshy and somewhat mealy on the outside. The pulpy, flattened



FIG. 6.—Australian Saltbush (*Atriplex semibaccata*), grown in the grass garden of the Department of Agriculture.

fruits are tinged with red at maturity, but dry out as soon as they fall from the plant. They are produced in enormous numbers and ripen continuously for three or four months, or under some climatic conditions, throughout the year. At the California experiment station it was determined that the seeds germinate better when sown directly on the surface without any covering. When they were harrowed in to the depth of 2 or 3 inches most of them either rotted before germination or the young seedlings were unable to reach the surface. Some practical stockmen have had good results in establishing this saltbush on an alkali range by sowing the seed on the ground when it was wet with heavy rains and at once driving a flock of sheep over the land, thus treading them into the soil. Sheep are especially fond of this saltbush, and cattle relish it if combined with other feed. Von Mueller states that in his opinion many of the valuable qualities of the Australian wools are due to the abundance of this

¹ See Farmers' Bulletin No. 108, on Saltbushes.

and other saltbushes in the regions in which the sheep are grazed, and Turner states that if the saltbushes were entirely exterminated it would tend to decrease the value of the wool. The plant may be propagated by cuttings, as well as from seed, and this method is to be preferred wherever the land contains much alkali. The seeds will germinate in the presence of an amount of soda salts which would entirely prevent the growth of cereals. This is especially true in the case of Glauber's salt, though there is of course a limit to the amount of alkali the plant will tolerate, as in the case of wheat or alfalfa. This saltbush is perennial in California, Arizona, and New Mexico, but must be treated as an annual wherever the winters are severe. In South Dakota plants from seed sown in May had just commenced to blossom at the time of the first hard frost in autumn. *Atriplex semibaccata* is the most promising of the Australian saltbushes for cultivation in this country, both because of its hardiness and the bulk of fodder produced. The forage contains 11.6 per cent of crude protein in the air-dry substance as compared with 14.3 per cent for alfalfa. Thus, 100 pounds of the dry substance will contain 8.7 pounds of digestible crude protein as compared with 10.6 pounds in alfalfa. The nutritive ratio is 1 to 4.5 for saltbush and 1 to 4.1 for alfalfa, so that it would seem to have nearly as high a feeding value as the latter, assuming that the extraordinarily large ash content does not prove detrimental to the animal.

No. 35. *Atriplex truncata*. Utah Saltbush.

Utah saltbush is one of the best of the annual species. It has much the habit of *A. semibaccata*, covering the ground with a thick mat of leaves and thereby preventing evaporation and the rise of alkali to the surface. It is common in northern Utah and Nevada and eastern Oregon on clayey soils impregnated with common salt and white alkali. A few seeds were distributed in 1896 by the Division of Agrostology, and a number of those who grew it have reported it as being of much promise for the reclamation of alkali soils. It is closely grazed by cattle wherever they have access to it, so that it is hard to find in sufficient amount to supply any quantity of seed. It is never abundant except where undergrazed or protected by fences.

No. 36. *Atriplex vescicarium*. Bladder Saltbush.

An Australian species, which Baron von Mueller considers one of the most valuable forage plants of that country, because of its abundance on the arid plains of the interior and the facility with which it disseminates itself. It withstands the utmost extremes of drought. It was introduced into Europe a number of years ago, and is now extensively planted throughout the delta of the Rhone, where it is of great value for sheep. It is a woody species which is easily multiplied from both cuttings and seed.

No. 37. *Atriplex volutans*. Tumbling Salt Sage.

A rank, leafy annual, which forms an upright compact mass 2 or 3 feet high. Nelson says that it may prove more valuable for certain alkali soils than any of the foreign species. It produces an abundance of seeds. Tumbling salt sage gets its name from the fact that, like a great many other plants native to the Western plains and prairies, the stem breaks off close above the ground in autumn, and the plant goes rolling across the country, scattering its seeds at every bound. It might prove a bad weed in grain fields because of this tumbling habit. It has very little forage value after the seeds have fallen.

No. 38. *Balsamorhiza deltoidea*. Balsam-root.

A stemless perennial with narrow, arrow-shaped leaves 8 to 12 inches long, and large, solitary or few, flowers borne on a long, leafless scape. It is a native on the arid plains of eastern Washington and Oregon, appearing in early spring. "Valuable for early grazing. Much sought after by stock." (Leckenby.)

No. 39. *Bigelovia*. Green Sage.

There are a large number of species of *Bigelovia* in the Rocky Mountain region.

They are light green or white-stemmed, shrubby perennials with mostly inconspicuous leaves and small heads of yellow flowers. All are rank smelling and resinous and are entirely unsuited for forage in summer; but in winter, after the summer grasses have disappeared, the green sages are eaten by both cattle and sheep. Not suited for cultivation, but valuable wherever they occur on the ranges.

No. 40. *Boehmeria nivea*. Ramie.

This well-known fiber plant, which has been introduced rather widely throughout the United States in the last twenty years, furnishes a large amount of forage of fair quality. It is eaten well by all kinds of stock; so that wherever this plant is grown for its fiber it is well to remember that it will also furnish valuable feed.

No. 41. *Boerhavia erecta*. Boerhavia.

This species and *B. linearifolia* are rather common in the mountains of New Mexico.

They are slender, viscid, red-stemmed annuals, with small leaves and delicate pink flowers; closely related to the garden Four-o'clock. This is one of the best of the native pasture plants for sheep.

No. 42. *Brassica napus*. Rape.

Rape, like the turnip, is a native of northern Europe, ranging eastward into Siberia.

Although it has long been cultivated in the Old World, it has received but little attention in America until within comparatively recent years, and is now much more widely grown in Canada than in the United States. Practically, all the rape grown in this country is the winter or biennial sort, but in Europe, especially in England, summer rape is widely cultivated. The seed yields about 33 per cent of expressed oil, which is of value for lubricating and is also used for lighting. The compressed rape-seed cake is used as a food for stock and as a fertilizer. It is regarded as particularly valuable as a fertilizer for flax and turnips. The seed is much used as a bird food. In this country rape is grown almost exclusively for forage, being used chiefly for soiling and summer and autumn pasturage. Dwarf Essex or English rape has been most widely cultivated. Recently a variety has been placed on the market under the name of Dwarf Victoria rape, or simply Victoria rape, which has given excellent results in New England, and also in the Northwest, yielding, as a rule, rather better than the Dwarf Essex. At the New Hampshire Experiment Station this variety is reported as yielding nearly 50 tons of green fodder per acre, and yields of 25 to 30 tons per acre are reported from South Dakota and elsewhere in the Northwest. Under average conditions a yield of from 10 to 20 tons or more may be expected from either of these varieties. Throughout the Northern States generally, seeding may take place from the 1st of June or possibly earlier, to the middle or last of July, according to the season and locality. In the South the seed may be sown in September or early in October. Under favorable conditions 3 pounds of seed per acre will be sufficient, and it will never be necessary to use more than 5 pounds per acre. The seed should be planted in drills far enough apart to allow cultivation. In practice the distance varies from 24 to 28 inches. For planting large fields a grain drill with some of the feed hoppers closed may be used. When the ground is clean and in proper condition, good results may be obtained by using the grain drill with all feed hoppers open, and giving no after cultivation. As a rule, however, it will be best to plant in wide drills and give sufficient shallow cultivation to aerate the soil and destroy weeds. With favorable conditions, good crops of rape may be obtained from broadcast

seeding; but whenever there is any danger of the surface soil becoming very dry during the time the seed is germinating, or when land is at all foul, drilling will give much better results. The rape is usually ready for use in about eight or ten weeks from the date of seeding. The general practice is to use it as a soiling crop or as pasturage. Sheep and swine may be turned into the field and allowed to remain until the rape is pastured off. Cattle may also be allowed to run in the field, but as they waste much of the forage by pulling up the plants or trampling them down it is a better plan to cut the rape with a scythe or mower and feed it green. With sheep and cattle care should be taken at first not to allow the animals to eat too much, as there is danger of injury from bloating. Hungry animals should not be allowed to eat their fill, and it is not best to turn them into the rape when the leaves are wet. There is no danger of bloating with swine. It is an excellent plan to have the fields so arranged that the sheep and cattle have access to an open pasture as well as to the rape. Animals should have free access to salt at all times when being pastured on this crop. Rape has a high feeding value. It makes an excellent feed for fattening sheep and swine and for producing an abundant flow of milk in milch cows. On account of danger of tainting the milk many people do not feed it to the cows until after milking. Rape can be used to good advantage as a part of the ration for animals that are being fed in pens for market or for the show ring. It is also a valuable food for young lambs at weaning time. By beginning as early as practicable in the spring and seeding at intervals of two or three weeks, a continuous succession of rape can be produced throughout the period when the permanent pastures are most likely to be short. Rape will endure quite severe cold weather and thus will last a long time after the ordinary pasture grasses succumb to the frost. By the use of this crop stock can be gotten into good condition for the holiday markets or for winter, and there need be no check in growth, fat, and milk production through insufficient succulent food during the late summer and autumn months, as is too frequently the case. Under favorable conditions two or three cuttings may be made in a single season from a field of rape grown as a primary crop. Mr. W. H. Heidman, of Kalispell, Mont., reports three cuttings the first season with a heavy yield of forage. He allowed the plants to stand the second season and obtained a fine yield of first-class seed. Not much attention has been paid to growing rape for seed in this country, possibly because of the fact that in most localities where this crop has been extensively grown the winters are so severe as to destroy the plants. It seems, however, that there are localities where rape can be profitably grown for seed, and farmers might well devote more attention to this feature of rape growing, since most of that now used is imported. (Thomas A. Williams, in Circular No. 12, Div. Agrostology.)

No. 43. *Brassica oleracea*. Cabbage.

An annual or biennial plant, indigenous to various parts of Europe and widely cultivated as a vegetable throughout the world. Cabbage is largely grown in some parts of Europe as a crop for soiling either sheep or cattle, and as a stable food in late autumn is far superior to turnips. It has been estimated that the crude protein of an acre of cabbage amounts to about 1,500 pounds. Where cabbages are grown as a commercial crop the waste leaves, trimmings, and heads that are under grade or fail to mature can be used to advantage in fattening a few head of sheep or young cattle.

No. 44. *Cajanus indicus*. Pigeon Pea.

An annual legume "extensively cultivated in India even up to the altitude of 6,000 feet." (Watt.) It is estimated that there are over 3,500,000 acres devoted to its cultivation as a supplementary crop. The seed forms one of the most common foods, being sold as split peas or ground into meal or flour and used for porridge.

Pigeon pea requires from nine to eleven or twelve months to ripen seed. The plants often grow from 10 to 15 feet high, with a stem 4 or more inches in diameter. Besides supplying a food crop in the seeds, the leaves are used as forage and the stems for fuel. Pigeon peas to the annual value of about \$100,000 are imported into the British West Indian islands to be used as food for the coolies employed on the sugar plantations. It has been cultivated four years at the Louisiana Experiment Station. It is very susceptible to frosts, and, requiring such a long season, is not adapted for cultivation in this country. There are two or three varieties cultivated in India, the more common being *bicolor*, with the standard of the flower veined with purple, and *flavus*, with yellow flowers. The former is a hot-weather crop, while the latter is much smaller and is grown as a winter crop. Roxburgh states that the yellow-flowered variety ripens in three months, while the other one requires nine months, but yields six times as much seed.

No. 45. *Capnoides occidentalis*. Yellow Larkspur.

A biennial, many-stemmed herb with finely dissected leaves and numerous racemes of yellow flowers. It is one of the earliest plants to commence growth in spring. All kinds of stock are fond of it. Formerly very abundant on the ranges from west Texas to Arizona, but now all but exterminated except where protected from stock.

No. 46. *Carex aristata*. Giant Sedge.

A perennial sedge, with stout running rootstocks and leafy stems 2 to 3½ feet high. It forms a large part of the growth in moist, boggy places in the upper prairie region and supplies a large amount of early pasturage and hay. The hay contains over 11 per cent of crude protein.

No. 47. *Carex jamesii*. Jimsedge.

A sedge which is abundant in the moist meadows of northern Utah, where it occasionally occupies the ground to the exclusion of other species. It is pastured or mowed, and produces a fair quality of hay.

No. 48. *Carex muricata*. Water Grass.

A sedge, native of Arizona and New Mexico; very abundant in low places on the mesas. It contributes a large part of the hay cut from wet meadows, and is relished by stock.

No. 49. *Carex pennsylvanica*. Pine Grass.

A perennial, turf-forming sedge characteristic of the fire glades in the lodge-pole pine forests of Oregon and in wooded areas eastward to the Atlantic. "It supplies some grazing for sheep when it first comes up in spring, but is not very highly esteemed nor considered very fattening." (Coville.)

No. 50. *Carex retrorsa*. Late-fruited Sedge.

A tufted, leafy sedge, 1½ to 3 feet high, growing in boggy places in the lake region of Minnesota and the Dakotas. It is readily eaten by stock. Seldom cut for hay, because of its growing in places too wet to be mowed, but an important factor in the natural forage of the region. Analyses show that it contains nearly 16 per cent crude protein.

No. 51. *Carex siccata*. Silver-topped Sedge.

A perennial sedge, spreading extensively by means of creeping rootstocks, with clustered, erect stems 1 to 2 feet high, and erect, narrow-pointed leaves, shorter than the stems. Common on dry bottoms and in swales in the Upper Missouri prairie region. It may be distinguished by its silvery brown heads and by its habit of forming extensive mats of turf. This is a very valuable species, as the hay contains nearly 15 per cent of crude protein.

No. 52. *Carex stricta*. Upright Sedge.

A slender, tufted, perennial sedge, forming large bunches 6 inches to 3 feet high. The leaves are long and narrow, sharp pointed, and rough on the margins. Common in low, wet meadows and along the margins of ponds and lakes throughout the prairie region. The hay contains 11 per cent of crude protein.

No. 53. *Carex stenophylla*. Dwarf Sedge.

A low sedge, growing in moist prairies. Analyses of this sedge show that it contains about 14 per cent of crude protein. Valuable for the grazing which it affords in the early spring.

No. 54. *Carex straminea*. Straw Sedge.

A perennial sedge, with erect, slender, clustered stems 1 to 3 feet high, and narrow, stiff leaves. Common in the Mississippi Valley. It contributes a large amount of forage in the localities where it is common. The hay contains about 8 per cent of crude protein.

No. 55. *Carex sychnocephala*. Narrow-fruited Sedge.

A slender, erect, perennial sedge with narrow, long-pointed leaves, longer than the stems, growing in large tufts 6 to 18 inches high, rare in boggy places along streams and lakes in the Upper Missouri prairie region. In localities where it occurs it adds considerable value to the early pastures. The hay contains 9 per cent of crude protein.

No. 56. *Carex vulpinoidea*. Fox Sedge.

A perennial sedge, common on the western prairies, with stiff, sharply three-angled stems 1 to 2½ feet high, and flattish, sharp-pointed leaves, longer than the stems. It grows in large bunches, and prefers low prairies and rather dry swales. It is readily eaten by stock. Analyses show that hay of this species contains over 10 per cent crude protein.

No. 57. *Centaurea americana*. Star Thistle.

This rather common weedy thistle, while considered a pest in eastern fields, has much value as a forage plant in semiarid regions. The young plants, up to the time the seeds commence to ripen, are eaten by stock and are apparently nutritious, as cattle pastured in old fields covered with star thistles fatten rapidly. It is said to increase the flow of milk when fed to cows.

No. 58. *Centrosema virginianum*. Spurred Butterfly Pea.

A twining perennial bean with trifoliate leaves and large, showy violet flowers an inch long. The pods are 4 to 5 inches long, many-seeded, linear, flat, thickened at the edges, and marked with a raised line on each side next the margin. Common in sandy woods in the Southern States, extending into tropical America. It furnishes valuable forage in woodland pastures.

No. 59. *Ceratonia siliqua*. St. John's Bread.

A leguminous tree, often attaining a height of 50 feet, indigenous to the eastern Mediterranean region, but introduced somewhat widely through the Southern States and in California. Its saccharine pods are valuable as feed for stock, and are sometimes eaten by children. The pods are abundantly produced, even in arid regions and in seasons of drought. They contain about 66 per cent of carbohydrates, and are fed in rations of about 6 pounds per day, crushed or ground. The best European varieties are propagated by grafting or budding.

No. 60. *Cercocarpus betulæfolius*. Mountain Mahogany.

A small tree or shrub occurring in the southern Rocky Mountain region. The twigs and leaves are browsed by cattle.

No. 61. *Chamaeneuon angustifolium*. Firewood.

A common plant in "burns" in the mountains of Oregon and Washington. "When young it is a favorite food of sheep." (Coville.)

No. 62. *Chamaerhodes erecta*. Dwarf rose.

A low herbaceous perennial 5 to 10 inches high, with much branched stems and dissected leaves. Grows on the high plains from Colorado to Montana. Cattle are very fond of it. Related to the cultivated Burnett clover.

No. 63. *Chenopodium*. Pigweed.

There are a large number of native and introduced species in the United States, all of which are eaten by cattle and sheep, contributing much valuable forage when young. They are adapted to arid and barren lands, as well as to cultivated fields, and should be included in the list of forage plants for trial in the grazing region of the West.

No. 64. *Chenopodium auricomum*. Blue Saltbush.

Blue saltbush is a shrub that was formerly abundant in the hottest portions of the interior of Australia, but has now almost entirely disappeared. The writer collected some of it in 1891 in Western New South Wales. It was in a thicket of "wait-a-bit" and other thorny acacias, protected by them from all browsing animals, much as tufts of succulent grasses are often found in cactus thickets in Texas and the Southwest. Blue saltbush is so called from its color, which varies from blue-gray to yellow. It is an excellent forage plant, and its introduction into the arid ranges of the Southwest is recommended. It seeds abundantly and may also be propagated from cuttings.

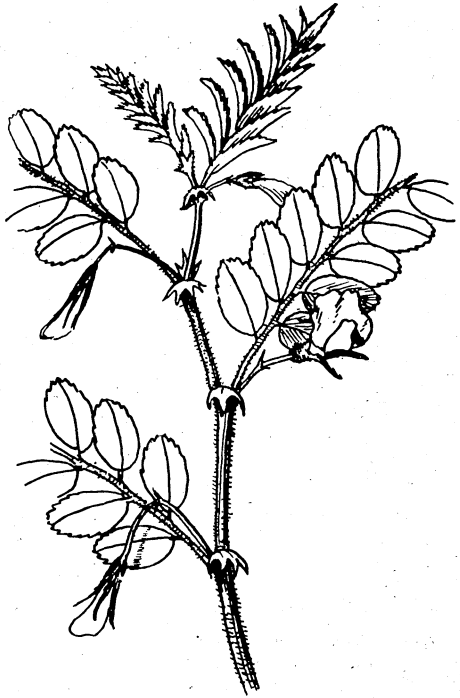


FIG. 7.—Gram (*Cicer arietinum*).

No. 65. *Cicer arietinum*. Gram.¹ (Fig. 7.)

An annual, with many upright stems from the same root. The leaves resemble those of the vetch, having seven pairs of small leaflets. These are oblong, soft-hairy all over, one-half inch long or less, and sharply toothed on the margins. The flowers are borne singly in the axils of the leaves on short stalks about one-half inch long. The pods are bladdery, inflated, from one-half to three-fourths of an inch long, and finely pubescent with glandular hairs. Each pod contains one, or very rarely two, large seeds, which are wrinkled and bear a fanciful resemblance to a ram's horn, whence the Latin name *arietinum*. The seeds are a little

¹ See Circular No. 7, Division of Agrostology.

larger than those of the common garden pea. About 30 to 50 pounds of seed are used per acre, depending upon whether it is sown in drills or broadcast. In India the largest acreage is in the northwest provinces, where the soils are similar to those west of the one hundredth meridian, and the climate is much like that of New Mexico and Arizona. All authorities agree that it is better suited to arid and semiarid regions than to humid ones, the crop apparently requiring a great many sunny days during its season of growth. Better results are secured in growing it with irrigation than without, although it makes a fair yield on comparatively dry soils. If continued experiments with this plant in the West prove that its average yield is as high as has been claimed, it will undoubtedly prove a valuable addition to the list of forage plants suitable to semiarid regions. Gram is a staple article of horse feed in India. The seed is also highly valued for fattening sheep and cattle. There is a considerable trade between India and England and other foreign countries. The total exports amounted in 1887 to over 15,000 tons. The average analyses of the seeds show that they contain about 20.5 per cent crude protein, 3.9 per cent fat, and 59.4 carbohydrates, having approximately the composition of the seeds of the common field pea. Digestion experiments have not been made with them, but their fattening qualities in use show them to be fully as valuable as the seeds of many of the other legumes. Besides serving as a fattening ration for cattle and sheep, the seeds and different parts of the plant find many uses among the natives of India. The green peas are eaten as a vegetable. The meal is used for porridge; and the parched peas are used either in the preparation of a beverage or in various confections and candies. The young plants are eaten as a salad and sometimes cooked like spinach. The forage is said to be actually poisonous to horses on account of the excess of oxalic acid in the leaves. Cattle eat it, but it often proves injurious to them, although to a less extent than to horses. However, this crop is not ordinarily grown as a forage crop, but for the seeds, and the seeds alone are used in India for feeding purposes.

No. 66. *Cichorium endivium*. Endive.

This culinary vegetable is particularly adapted as a pasture plant for extremely arid regions, as it matures seed which will germinate in the hottest deserts of central Australia. (Von Mueller.)

No. 67. *Cichorium intybus*. Chicory.

A well-known perennial, indigenous to Europe and northern Asia, where it is found growing wild along roadsides and in old fields. It is a good fodder plant, especially for sheep, and can be kept growing for several years if it is cut before flowering. The roots are much used as a substitute for coffee.

No. 68. *Citrullus vulgaris*. Tsama Melon.

A wild watermelon from the Kalahari Desert in South Africa. There are two kinds native to this great waterless desert—one with bitter fruits, the other with sweet watery ones. Seeds of the latter were secured by the Department of Agriculture from Prof. Peter MacOwan, Government botanist of Cape Colony, and were cultivated in 1898 at the Arizona Experiment Station with a view to securing seeds for a more general distribution. The Tsama melons are round, about 4 inches in diameter, and are produced in the greatest abundance. In the Kalahari Desert they form at times the only source of water for travelers crossing this great "Thirstland," and the herds of antelope that roam these wastes subsist upon them. They are especially adapted to withstand great extremes of temperature and drought, and hence would be valuable for wide introduction through the deserts of Arizona and southern California. Although small, the fruits supply both food and drink for stock and the passing traveler.

No. 69. *Clitoria mariana*. Butterfly Pea.

A low ascending or twining legume with pinnately trifoliate leaves and pale-blue flowers 2 inches long. It grows on dry hills and banks of streams in the Eastern and Southern States. A nutritious forage plant for woodland pastures, but usually too scattering to be of much value.

No. 70. *Conanthus hispidus*. Conanthus.

A heavy-scented, low perennial with small hairy leaves and blue flowers. It is one of the earliest plants to appear in spring and is much sought after by sheep. Conanthus grows rather abundantly in the southern Rocky Mountains, and although insignificant in appearance is highly prized as a grazing plant.

No. 71. *Convolvulus edulis*. Sweet Potato

The fleshy roots are used in many parts of the Southern States as feed for cattle, and the vines are cured on racks like cowpeas and used for hay

No. 72. *Crotalaria juncea*. Sunn-hemp.

A tall, woody annual legume with oblong sessile leaves and terminal spikes of large yellow flowers. It was formerly cultivated extensively in India as a fiber plant, but has now been largely displaced by jute and ramie. In northern India the upper and more tender portion of the plant is cut for hay, and the seeds are gathered for feeding to cattle. Sunn-hemp has been grown at some of the Southern experiment stations. It is pronounced of little value for either forage or fiber as compared with other plants in common cultivation.

No. 73. *Crotalaria lupulina*. Rattlers.

An annual legume with short, bladder pods in which the seeds rattle freely when ripe. It grows in New Mexico and Arizona. Although it is said to have some value as forage, it should be looked upon with suspicion because of its close relationship to the Rattle-pod pea (*C. sagittalis*), one of the worst of the poisonous loco weeds of the humid prairies.

No. 74. *Croton*. White Sage.

Several species of these supposedly poisonous plants grow on the ranges in Texas and the Southwest. A number of them are commonly considered good forage plants by stockmen. Others may perhaps prove poisonous, but until this point is definitely determined the Texas cattle will undoubtedly continue to thrive on these rank-smelling weeds. The white sages are especially valued as winter forage.

No. 75. *Cyamopsis psoraloides*. Guar.

A stout, erect annual legume 2 to 3 feet high, extensively cultivated as a food and forage plant in India. It is a summer crop, requiring from four to six months to reach maturity. The seeds are largely used in portions of India for fattening cattle, and contain about 30 per cent of crude protein, approaching in value those of the soy bean. Guar has not been cultivated in the United States

No. 76. *Cyperus erythrorhizos*. Chestnut Sedge.

An annual sedge with upright stems from 6 inches to 2½ feet high, leafy at the base, and with four or five leaves clustered about the inflorescence at the top. The flower clusters are usually bright chestnut-brown. Widely distributed over the prairie region, where it grows in rich, moist meadows. The hay contains over 10 per cent of crude protein, and while this sedge is not abundant, it adds no little value to native pastures and wet meadows.

No. 77. *Cyperus esculentus*. Chufa.

A perennial sedge, spreading extensively by underground stolons, which produce enormous numbers of edible tubers. In rich, sandy loams it is often cultivated

for hogs, which are turned into the field in autumn to root up the tubers. The tubers contain from 17 to 28 per cent of oil, 27 to 29 per cent of starch, and 12 to 21 per cent of gum and sugar. This sedge is an important forage plant for desert regions. The oil extracted from the tubers is said to be excellent for culinary purposes. In France brandy is manufactured from them.

No. 78. *Cyperus rusbyi*. Rusby's Sedge.

A perennial sedge, from the mountains of southern New Mexico and Arizona. Very slender and not leafy, but yielding a considerable amount of large and heavy seed. Stockmen say that this sedge was formerly very abundant, but it is now to be found only in the upper canyons where inaccessible to cattle. All kinds of stock are fond of the ripe seeds. This species might well be given a trial in cultivation.

No. 79. *Cyperus strigosus*. Tule.

A tall sedge, with the stems 4 to 6 feet high, growing in marshy places in California and Arizona. It is much relished when young by all kinds of stock.

No. 80. *Cytisus proliferus albus*. Tagosaste.

A perennial shrub or low tree, native of Madeira and the Canary Islands. Great claims have been made concerning its value as a forage plant for arid countries, and it has been tried in all of the Western States. Tagosaste is at best no better than many of the native forage shrubs, and it does not approach alfalfa either in yield, feeding value, or adaptability to arid conditions. The seeds germinate very slowly, and the plants make a very poor growth at first, until well established. The directions for cultivation are to steep the seeds twenty-four hours in warm water to soften the outer seed coats and hasten germination; sow them in a seed bed, and finally transplant to the field where they are to grow, setting out the plants in rows 10 to 15 feet apart. Cultivation is then recommended the first year or two. The yield of leaves and woody shoots from an acre of tagosaste is entirely out of proportion to the cost of labor necessary for its production. There are many forage plants which excel it in yield, feeding value, and resistance to drought. The best use to which tagosaste may be put is as an ornamental in landscape gardening because of its silvery gray-green leaves. As a forage plant it is a failure.

No. 81. *Cytisus scoparius*. Scotch Broom.

A shrubby, perennial legume, native of Scotland. The young growth is chiefly valued as a food for sheep and other stock in winter. A plant of this grown in the grass garden at Washington, D. C., was killed by the freeze in February, 1899, when the temperature fell to -15° F. Scotch broom was introduced into New Zealand as a forage plant for sheep and has spread so rapidly that it has become a bad weed. It has been freely recommended as a soil renovator for barren lands because of the large amount of potash contained in the ash, it being claimed that the roots bring this fertilizer up from the deeper levels to the surface and within reach of the roots of succeeding crops.

No. 82. *Dalea lasianthera*. Early Dalea.

A legume, abundant in southern New Mexico. One of the earliest forage plants. "Sheep go wild over it." (J. K. Metcalfe.)

No. 83. *Dalea scoparia*. Bushy Dalea.

A wild vetch, with gray, almost leafless stems; abundant on the mesas of New Mexico and Arizona, supplying forage during the dry season. It appears to be worthy of cultivation.

No. 84. *Dasyllirion texanum*. Sotol.

A fodder plant of the lily family, which occurs throughout western Texas and northern Mexico. It grows abundantly in the great bend of the Rio Grande and west of the Pecos and is highly esteemed, producing fodder for sheep in the winter season and during periods of extreme drought. The appearance of the plant is something like that of a large pineapple, growing on a trunk 2 to 5 feet high. The narrow leaves, 3 to 4 feet long and one-third to one-half inch wide, radiate in every direction, forming a rosette at the top of the trunk. The portion eaten is the inner cabbage-like heart, which remains after the spiny leaves have been cut off. An analysis of this, made by the Chemist of the Department of Agriculture, shows that it contains about 12 per cent of sugar and gum and about 3 per cent of crude protein, besides 65 per cent of water. No attempt has been made to cultivate sotol, and it is becoming exterminated in many portions of its range. Sheep can exist upon it four or five months in the winter without access to water, so that it would be an excellent forage plant for dissemination and cultivation in arid regions where the winters are not too severe. Another species (*D. wheeleri*), is of similar use and value in New Mexico.

No. 85. *Desmanthus brachylobus*. Desmanthus.

An erect, perennial legume, 1 to 4 feet high, with twice-pinnate leaves and sickle-shaped pods 1 inch long, borne in a dense globular cluster. Common on bottom lands and alluvial banks from Minnesota to Kentucky, Florida, and Texas. It is said to be much relished by horses and other stock.

No. 86. *Desmodium acuminatum*. Leafy Beggarweed.

A valuable forage plant, growing in rich woods from Canada to the Gulf. The leaves are crowded at the summit of the stem, from which arises the elongated naked raceme.

No. 87. *Desmodium canadense*. Canada Beggarweed.

A tick trefoil with hairy stems 3 to 6 feet high, and oblong-lanceolate, obtuse leaflets longer than the petiole. In rich, dry woods from New Brunswick to Minnesota and Kansas. A species deserving of trial under cultivation.

No. 88. *Desmodium nudiflorum*. Naked-flowered Beggarweed.

Common in dry woods throughout the Eastern and Southern States. The leaves are all crowded at the summit of the sterile stems, the elongated raceme springing directly from the roots. This tick trefoil furnishes considerable forage in woodland pastures.

No. 89. *Desmodium paniculatum*. Texas Beggarweed.

A tall, slender, leafy legume, native in west Texas. It makes an excellent quality of feed for stock, and when growing thick enough to mow is convertible into first-class hay. It thrives best on low, moist soils, but occurs also on the drier uplands. It resembles the Florida Beggarweed in general appearance, and ought to be tried in cultivation to find out whether it would do as well in the semi-arid Southwest as that plant does in Florida.

No. 90. *Desmodium pauciflorum*. Few-flowered Beggarweed.

A perennial woodland form, with leaves scattered along the low ascending stems, 8 to 15 inches high, the inflorescence few-flowered and terminal. Common in woods from Canada to Kansas and southward. Valuable as a forage plant for shady pastures.

No. 91. *Desmodium tortuosum*. (*D. molle*.) Florida Beggarweed.¹ (Fig. 8.)

An annual leguminous plant, indigenous to Florida and the Gulf States, extending into the West Indies and tropical America. This is undoubtedly one of the very best forage plants for light, sandy soils. The stems are tall, and if grown at considerable intervals are woody, but where seed is scattered thickly over the ground the entire plant can be converted into hay or silage. Florida Beggarweed springs up naturally in fields wherever the ground has been disturbed, about the middle of June, and matures a crop in seventy to eighty days. On sterile clay soils in the vicinity of Washington, D. C., beggarweed grows 3 to 4

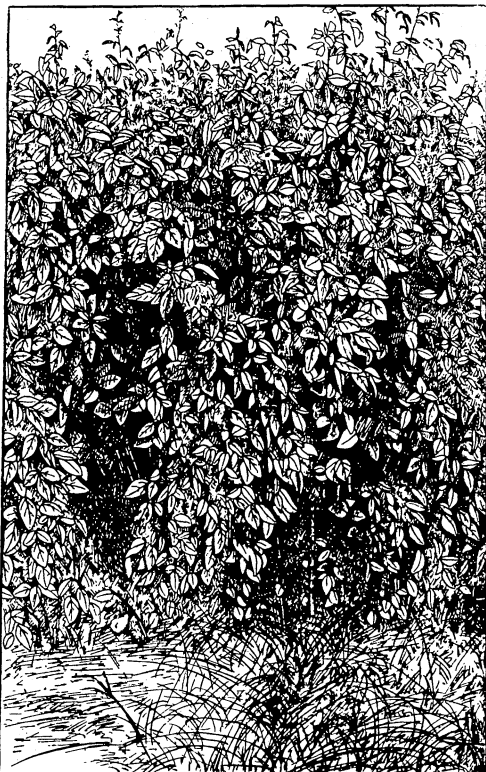


Fig. 8.—Florida Beggarweed (*Desmodium tortuosum*), grown at the Mississippi Agricultural Experiment Station—plants 7 to 8 feet high.

feet high. In the rich, moist, sandy fields along the Gulf of Mexico it grows from 6 to 10 feet high. Horses, cattle, and mules are very fond of it. According to analyses of beggarweed made at the Florida Experiment Station, 100 pounds of hay consisting of the upper portion of the plant, mainly leaves and branches, contained, before maturity, 19.42 pounds of crude protein and 65 pounds of carbohydrates; and when seed was ripening, 15.75 pounds of crude protein and 69.15 pounds of carbohydrates. Analyses at the Department of Agriculture gave as high as 21 per cent of crude protein before flowering. Digestion experiments have not been made, but as the hay is readily eaten by horses, mules, and cattle, and seems to be relished by them, it is undoubtedly as digestible as red clover. This plant, like other legumes, takes a part of its supply of nitrogen from the air, and does not depend wholly on the nitrates in the soil. It produces a greater bulk of feed than the cowpea, and grows without much care on cultivated lands, but rapidly degenerates into an insignificant weed if the field is no longer cropped. Beggar-

weed thus becomes one of the most valuable forage plants of subtropical regions on rich lands, excelling cowpeas both as a hay plant and soil renovator. Yields of from 4 to 6 tons of hay per acre are not unusual.

No. 92. *Desmodium triflorum*. Three-flowered Beggarweed.

A densely matted, perennial, leguminous herb, occurring in tropical regions of Asia, Africa, and America. Roxburgh states that it helps to form the most beautiful turf in India, and that cattle are very fond of it. It springs up in all soils and situations, furnishing an excellent fodder in places too hot for ordinary clover.

¹ See Circular No. 13, Division of Agrostology.

It deserves trial in the warmest portions of the Southern States. There are many other species of *Desmodium* in the Eastern and Southern United States, some occurring in woodlands and others found only in open prairies. All are eaten with avidity by stock, and all are worthy of an extended trial in cultivation, although on account of their jointed pods with minute hooked hairs they are perhaps liable to become weeds. The foliage produced by them is exceedingly nutritious. The *Desmodiums* are all nitrogen gatherers, and on that account are valuable both as forage and green manure.

No. 93. *Dioscorea batatas*. Chinese Yam.

A rank-growing vine, cultivated in all tropical countries for its edible roots. It is propagated by means of aerial tubers, which form in the axils of the leaves. The fleshy, mucilaginous roots serve as food for man, and are readily eaten by all kinds of stock. A drawback to its cultivation is the labor required for digging the crop, the roots being largest at their lower end. Quite large yields of the aerial tubers have been reported, and it has been suggested that the crop would be a valuable one for fattening hogs. The Chinese yam has been quite extensively tried in Florida and the Gulf States.

No. 94. *Echinosperrum redowskii*. Stickseed.

This and other perennial borages are plentiful in the Rocky Mountain region. Sheep are very fond of them. They supply a goodly amount of forage in early spring.

No. 95. *Eleocharis obtusa*. Tufted Spikerush.

A tufted annual spikerush with leafless stems 8 to 18 inches high. It grows in shallow ponds and marshes in the Upper Missouri region, supplying a fair quality of forage in localities too wet for grasses and sedges. The hay contains 10 per cent crude protein.

No. 96. *Eleocharis palustris*. Common Spikerush.

A spikerush with slender, cylindrical, upright, tufted stems, 1 to 4 feet high, from perennial roots and running rootstalks. Very common in shallow water or in wet meadows from Lake Champlain along the Great Lakes to Minnesota and northward. The leafless stems yield a considerable amount of early pasturage in wet meadows. The hay contains 9½ per cent of crude protein.

No. 97. *Eleocharis spacelata*. Tuberous Spikerush.

A bog rush native to swamps in the Australasian tropics. Yields large numbers of sweet, edible tubers. Might be introduced into swamps and marshes in Florida as food for swine.

No. 98. *Enchylæna tomentosa*. Woolly Saltbush.

An erect, sprangled saltbush with hairy stems and fine leaves. This Australian saltbush has been cultivated in the grass garden at Washington, D. C. Apparently a good species for introduction in the Southwest.

No. 99. *Ephedra nevadensis*. Ephedra.

A leafless shrub with slender green branches. It grows throughout the Southwest, but is not very common. It is generally found on the highlands and, as a rule, on rocky or gravelly soil. It is known to possess medicinal qualities, being an excellent blood purifier. Cattle eat it greedily, so that it may be considered valuable as a forage plant.

No. 100. *Equisetum laevigatum*. Scouring Rush.

The most common scouring rush of the prairies and Rocky Mountain region. The plants are less harsh than the Eastern forms. When young, the succulent stems are greedily eaten by cattle and horses. Another species from southern California is sometimes responsible for the death of horses. The siliceous stems per-

forate the walls of the stomach and intestines in the same way that cactus spines cause the death of many cattle in the Southwest.

No. 101. *Erigeron canadensis*. Horseweed.

A bristly, hairy, erect, wand-like, annual composite, with linear, mostly entire leaves, and very numerous heads of small, dirty white flowers. A cosmopolitan weed growing in waste lands, fence corners, and along roadsides. This species has been reported valuable as sheep fodder in the arid regions of New Mexico and Arizona.

No. 102. *Eriogonum brevicaule*. Woolly-joint.

A yellow-flowered perennial from the Red Desert of Wyoming. Prof. Aven Nelson says that it is grazed by cattle in summer in preference to other feed. There are about 200 species of *Eriogonum*, mostly Western. All have value as forage plants where they occur abundantly.



FIG. 9.—*Alfilaria* (*Erodium cicutarium*).

No. 103. *Erodium cicutarium*. Alfilaria. (Fig. 9.)

This weedy annual has nearly as large a distribution as the following species, but is of less value. This species has been regarded by agricultural writers as the true *Alfilaria*, but according to Professor Greene its occurrence is rare compared with that of *E. moschatum*, and its foliage is more fragrant and less readily eaten by stock.

No. 104. *Erodium moschatum*. Alfilaria.

An annual of the Geranium family which occurs abundantly, and is of much value in pastures over a large extent of territory on the Pacific slope. Elsewhere in the United States it is sparingly introduced, and usually regarded only as a weed, though not troublesome. It

springs up during the wet season from January to June, and grows on all kinds of soils from the coast up to the snow line. It is an excellent pasture plant, but seldom reaches a sufficient height to be mowed for hay. It is eaten by all kinds of stock as long as it is green, but when dry is of little value because the stems are brittle and break up into small fragments. It is cultivated to some extent, and has been recommended for sowing in pasture lands in the Southern States. A related species, *E. cynnorum*, native of Australia, is considered one of the best forage plants of the drier regions of that continent.

No. 105. *Ervum lens*. Lentil.

An annual legume, native to and widely cultivated in Europe. The leafy stalks make good forage. Its seeds are palatable and nutritious as food for man and domestic animals. It is suited for cultivation in cold climates and in the

mountains at high elevations. The seeds retain their vitality for about four years. The variety called the "winter lentil" is more prolific than the "summer lentil." In common with most other leguminous plants, a calcareous soil is essential for its prolific growth.

No. 106. *Eurotia lanata*. Winter Fat. (Fig. 10.)

A white-hairy perennial, 1 to 2 feet high, closely related to the saltbushes, and growing with them on strongly alkaline soils. The cottony seeds are produced in great abundance, and both seeds and stems are eaten greedily by all grazing animals, so that this plant is now almost exterminated wherever cattle have free range. It is widely distributed from Manitoba to Texas and westward to the Sierra Nevadas, and wherever it occurs is highly spoken of as a winter forage plant. Experiments in the grass garden at Washington, D. C., indicate that it makes a fine growth on cultivated land. The seed was sown on the surface and raked in. Seed might be gathered by ranchmen and sowed in spring on land which had been disked or harrowed, and while it could not be cut for hay it would make excellent winter grazing for either sheep or cattle. It thrives on alkaline soils and will tolerate moderate amounts of the white alkali. Stock grazed on lands where winter fat grows thrive well and are said to be remarkably free from disease because of the tonic properties of this plant. It is worthy of cultivation, and should be given a trial wherever seed is obtainable from the wild plants.



FIG. 10.—Winter fat or sweet sage (*Eurotia lanata*).

No. 107. *Faba vulgaris*. Horse Bean.

A coarse, erect, rank-growing annual of considerable value as a forage plant, grown in the Eastern United States, and more extensively in Europe. The beans, which contain about 33 per cent of starch, are used for fattening cattle, but their use, if long continued without change or without proper admixture of other foods, often results in paralysis on account of the bitter poisonous alkaloids which the seeds contain. This crop is largely grown in England. It has been experimented with in many of the Eastern States with fair results, although it is believed that peas and clover are more satisfactory.

No. 108. *Fagopyrum esculentum*. Buckwheat.

Buckwheat, a well-known annual, cultivated for its seeds, is a native of northern Asia, and has been under cultivation about one thousand years. It succeeds in cold climates on the poorest land. For fodder or as green manure, clayey soils produce the largest crops. On account of the short season in which it matures, it is adapted to cultivation in high latitudes and alpine regions. It is an excellent soiling crop, either fed alone or with oats or green corn, and is recommended for milch cows.

No. 109. *Fallingia paradoxa*. Apache plume.

A low undershrub occurring in the mountains of west Texas and New Mexico, distinguished by the feathery, persistent styles. The leaves and twigs are browsed by cattle and sheep.

No. 110. *Fimbristylis laxa*. Sedge.

Leafy perennials growing in low wet meadows in the South. This and other species often constitute the bulk of the grazing in marshy places. Cattle do not fatten on lowland pastures, but make good "feeders" and "stockers" for topping off with corn or cotton-seed meal.

No. 111. *Franseria dumosa*. *Franseria*.

A shrubby plant related to the cocklebur, which is one of the most characteristic plants of the Colorado desert and the dry sandy plains of southern California. It is valuable feed for stock, either dry or green. It produces an abundance of burs, which are eaten by cattle and horses, and are as fattening as grain. It also makes a very fine feed for sheep. It dries up after the winter rains, but greens out after every shower.

No. 112. *Galactia canescens*. Miller Bean.

A perennial legume from the Mogollon Mountains in New Mexico. It has the vetch habit of growth, has been grown to a limited extent in cultivation, and is one of the most promising of the native arid-land forage plants. The yield of both seeds and foliage increases remarkably under favorable conditions, and the stout, woody root enables the plant to withstand the longest drought. Cultivated experimentally by Mr. James K. Metcalfe, of Silver City, N. Mex.

No. 113. *Galactia regularis*. Smooth Milk Pea.

A low, prostrate or twining, perennial bean with nearly smooth stems, trifoliate leaves, and purple flowers in interrupted or nodding racemes. Common in sandy woods from New York to Florida and Mississippi. It makes an excellent summer forage for milch cows, and adds value to woodland pastures.

No. 114. *Galactia volubilis*. Milk Pea.

Like the last species, but with stems and leaves soft and downy. It is of some value as summer forage in the Eastern United States.

No. 115. *Galega officinalis*. Goat's Rue.

A perennial legume with erect, branching, leafy stems $1\frac{1}{2}$ to 3 feet high, pinnate leaves, and purple flowers borne on a long-stalked spike. A forage plant of value on account of its resistance to drought, which has been recommended for the northern prairies and central Rocky Mountain districts. It is usually fed green, as it makes a poor quality of hay, and is not readily eaten by stock until they have become accustomed to its taste. The hay contains 17 per cent of crude protein. Goat's rue has been tried in the grass garden at Washington, D. C. It does not at all compare with alfalfa, which it much resembles in appearance, in either yield or feeding value.

No. 116. *Galium*. Bed Straw.

There are a number of low, shrubby, perennial species of bed straw in New Mexico, which are highly regarded as forage for sheep on the ranges.

No. 117. *Geranium carolinianum*. Stork's Bill.

An annual with rounded, cut leaves and numerous pink flowers. Grows in western Washington and Oregon on poor land. "During the cooler parts of the year it is often quite plentiful and is an excellent pasture plant." (A. B. Leckenby.)



FIG. 1.—VELVET BEANS IN ORANGE GROVE IN FLORIDA.



FIG. 2.—SOY BEANS GROWN IN GRASS GARDEN, U. S. DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

No. 118. *Gleditsia triacanthos*. Honey Locust.

A leguminous tree 30 to 60 feet high, native of the Eastern United States. The pods are eaten by stock, and the young growth is browsed by cattle.

No. 119. *Glycine hispida*. Soy Bean.¹ (Plate I, fig. 2; and fig. 11.)

The soy bean has been cultivated as human food and for green manure in China and Japan for many centuries, but has only been brought to the attention of American farmers as a forage crop within the last twenty years. In oriental countries various preparations are made from the seeds, which take the place of meats and meat products in the dietary of the people. Here, however, the seeds are used only as cattle foods or, when parched, as a substitute for coffee. They are especially rich in fats and nitrogenous compounds. Of all legumes in cultivation the peanut alone exceeds it in the amount and digestibility of its food constituents. The soy bean requires about the same class of soils as indian corn, and will grow about as far north as that crop can be depended on. The best results with it have been obtained in the region between the thirty-seventh and forty-fourth parallels east of the Rocky Mountains. The region best adapted to it, then, is the "corn belt," a circumstance which argues well for its future use and value in conjunction with corn for fattening animals. The soy bean should be planted in late spring or early summer, after the ground has become warm. In general, the early varieties should be used if a seed crop is desired, and the medium or late varieties if it is to be used as forage, it having been found that the latter much excel the former in value for that purpose. In some parts of Virginia the soy bean is planted in the corn rows in alternate hills, or between the rows at the time of the final cultivation. Usually, however, it is grown as a main crop, either broadcast, for forage, or in drills when cultivated for seed. The amount of seed required when it is sown in drills is less than when planted broadcast, varying from 2 to 3 pecks per acre, and in the latter case 3 to 4 pecks. The rate of growth is quite rapid, and unless the field is very weedy the crop does not require much cultivation. The crop should be cut for hay from the time of flowering until the pods are half formed, using a scooter or V-shaped plow which cuts off the roots just below the surface of the ground, and permits the stalks to be raked into windrows. The stems are too woody to be mowed with a machine. Later the stems become more coarse and woody, and the feeding value rapidly declines. One hundred pounds of soy-bean hay contain 88.7 pounds of dry matter. Of the 51 pounds of digestible substances, 10.8 pounds consist of crude protein, and the nutritive ratio is about 1 to 3.9. The crop may be converted into good silage, and for this purpose should not be cut until the seed

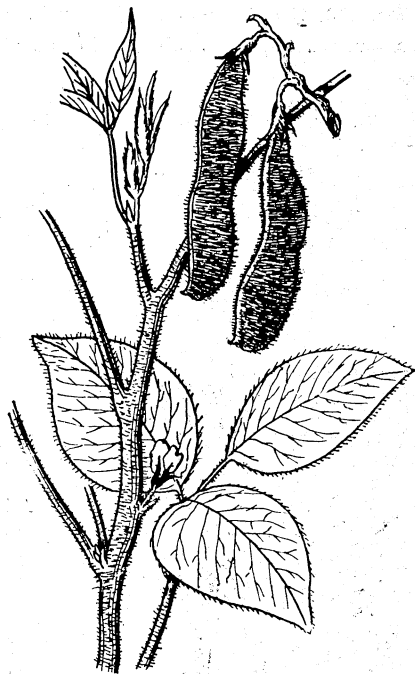


FIG. 11.—Soy Bean (*Glycine hispida*).

¹ For further remarks on Soy Bean see Farmers' Bulletin No. 58, Division of Agrostology.

is nearly ripe. The chief value of silage is that it provides a succulent food during the winter time, when green forage is not available; but as certain changes take place in the silo, which render a part of the protein indigestible, it is better to depend upon corn than to use any leguminous crop for this purpose. The ripe soy beans are among the richest of concentrated foods. An average of American analyses shows them to contain 34 per cent of protein, 17 of fat, and 33.8 of carbohydrates. The rate of digestibility is high. Thus, there are in 100 pounds of soy-bean seed 10.8 pounds of water and 66.8 pounds of digestible food, consisting of 29.6 pounds protein, 16 pounds fat, 2.6 pounds fiber, 17.6 pounds carbohydrates, and 1 pound of ash, with a nutritive ratio of about 1 to 1.3. On a basis of 8 tons of green forage it has been estimated that about 1.1 tons of digestible substances are contained in the hay crop grown on 1 acre, of which amount one-sixth is protein.

No. 120. *Grayia spinosa*. Saltbush.

A somewhat spiny shrub growing on alkali deserts in the West. It is of the same family as the Australian saltbush. Sheep and cattle graze the young leafy twigs and fatten rapidly on the seeds. One of the most valuable winter forage plants in Wyoming and Colorado.



Fig. 12.—*Sulla* (*Hedysarum coronarium*).

No. 121. *Guillemina illecebroides*. Sheep-lick.

A prostrate, matted annual with minute leaves which are bright green above and cottony beneath. Very common on the ranges in New Mexico and Chihuahua. It is related to the tumbleweeds. "Sheep lick it up like salt." (Metcalf.)

No. 122. *Gutierrezia microcephala*. Dwarf Broom-weed.

A low bushy perennial with linear leaves and small yellow flowers and a native of southern Texas, where it is of some value as a winter forage plant. The flower heads of a number of the wild tansies are grazed by cattle and horses with evident relish.

No. 123. *Hedysarum americanum*. American Sweet-weed.

A perennial leguminous herb growing in Montana and Wyoming. The pink flowers are borne in long lateral racemes. Grows on

dry hillsides and is often eaten by stock.

No. 124. *Hedysarum boreale*. Northern Sweet-weed.

A taller and more leafy plant than the above, with racemes of yellow flowers. It is found in open woodlands in the northern Rocky Mountains. Cattle are said to be quite fond of the forage.

No. 125. *Hedysarum coronarium*. Sulla. (Fig. 12.)

This perennial legume is a native of southern Italy, and was first introduced into cultivation in 1766. It grows best on sandy or clayey soils which are well drained, or where the ground water is not less than 6 to 10 feet below the surface. It will withstand slight frosts, but is killed if the roots are frozen. It

is a perennial in southern Italy, Sicily, and Algeria, but must be resown each year in northern Italy, where the winters are more severe. It has been introduced into this country for trial in Florida and the Gulf States. The practice is to sow the seeds in September or October, on land that has been deeply plowed and thoroughly pulverized, either alone or with winter oats or wheat. After the latter has been taken off the field, a crop of sulla 4 to 6 feet high springs up and is ready to cut from the latter part of May to July. In feeding value it compares very favorably with alfalfa, and is better adapted to tropical or sub-tropical climates, provided seed is sown on well-drained and well-prepared land. If the seed bed is only given a shallow cultivation in preparation for sowing, it will require a full year before one crop can be taken from the land. The same precautions are necessary in using sulla as a soiling crop as with clover and alfalfa, to prevent loss of cattle through bloating. Sulla has not proved as successful as alfalfa in the South.

No. 126. *Helenium tenuifolium*. Sneezeweed.

A very common weedy plant in Southern pastures and old fields. It is readily eaten by stock, but can hardly be called a forage plant because it makes milk bitter.

No. 127. *Helianthus annuus*. Sunflower.

The sunflower is a well-known annual weed, a native of Peru, which has become widely spread throughout the United States. Its leaves and heads make good green fodder for cattle and horses, and its oily seeds, which are produced at the rate of from 20 to 50 bushels to the acre, furnish an oil cake which is a valuable stable food. Six pounds are required to seed an acre. It is said to endure the excessive summer heat of central Australia better than any other cultivated herb that has been tried there, and deserves to be regarded as other than a useless weed in our own arid and semiarid grazing pastoral districts. It is regarded as a good crop to grow on alkali soils.

No. 128. *Helianthus tuberosus*. Jerusalem Artichoke.

This artichoke is a native of North and South America, and has been cultivated in this country for fifty years or more for its edible tubers. Fed to milch cows, these tubers, which contain a large amount of sugar and gum, greatly increase the flow of milk. The leaves are also greedily eaten by all kinds of stock. Artichokes are planted like potatoes, but at greater distances apart, and the yield is from 200 to 500 bushels per acre. On rich and friable soils it yields uninterruptedly for several years without replanting. The tubers should be dug in autumn after the upper part of the plant has been killed by frosts, as at that time they contain the most sugar. It grows best in loams containing a high percentage of potash. Artichokes are of most value as food for hogs, which may be penned on the field and allowed to harvest the crop themselves. There are quite a number of varieties in cultivation.

No. 129. *Hippocrepis comosa*. Horseshoe Vetch.

This perennial fodder plant is quite widely cultivated in middle and southern Europe and northern Africa. It grows best on stony ground, especially on soils containing lime, furnishing early and nutritious though scant forage. It is worthy of trial on stony soils in the South.

No. 130. *Hoffmanseggia stricta*. Blue-weed.

A low perennial legume, very common in the Southwest, often occurring as a bad weed in cultivated lands. The blue-green foliage is grazed by stock, and the sweetish underground tubers are eaten by hogs. It grows luxuriantly in fields and is worthy of trial as a hay plant in semiarid districts. It may be exterminated by planting sorghum or Kafir corn or any rank-growing crop to overshadow it.

No. 131. *Iris pabularia*. Flag.

A slow-growing perennial used for fodder in central Asia. Seed was planted in the grass garden at Washington, D. C., in May, 1897. The plants only commenced to blossom in May, 1899. The amount of forage produced is insignificant, and the plant is not worth cultivating.

No. 132. *Juncoides parviflorus*. Wood Rush.

A grass-like, leafy rush, quite abundant on the lower mountain slopes and even above timber line in Colorado and the adjoining States. Cattle and sheep eat it readily.

No. 133. *Juncus balticus*. Wire Grass.

A rather common and widely distributed rush growing in low meadows. It supplies a small amount of forage. It makes hay of the first quality in the mountain meadows of Colorado and the Northwest.



FIG. 13.—Black Grass (*Juncus gerardi*).

No. 134. *Juncus gerardi*. Black Grass. (Fig. 13.)

A leafy rush with somewhat harsh, slightly flattened stems, 1 to 2 feet high, common in tide-water marshes along the Atlantic coast and extending westward through the region of the Great Lakes. It is the principal constituent of some of the marsh hay cut along the coast; it has a fair feeding value, and is important as a forage plant which will grow where better and more nutritious species will not thrive.

No. 135. *Juncus nodosus*. Big Headed Rush.

A smooth, erect, stiff, leafy rush, 1 or 2 feet high, with very slender, creeping, tuber-bearing rootstocks. The leaves are slender and long-pointed. This rush is common in boggy places and wet meadows in the prairie region and is of some little value as early pasturage. The hay contains 7 per cent of crude protein. The plant becomes too coarse for forage during the summer months.

No. 136. *Juncus tenuis*. Slender Bog Rush.

A slender, tufted, wiry rush, 6 to 18 inches high, with leaves about 6 inches long; common in the prairie region. Though rather tough and wiry, it is readily eaten by stock. Hay made

of it contains about 7 per cent crude protein.

No. 137. *Kochia*. Gray Bush.

There are a dozen or more species of the gray bush (*Kochia*) in the arid portions of Australia. All are shrubby perennials, more or less sought after by cattle and sheep, and are correspondingly valued by owners of stock. One characteristic feature of all of them is that their leaves and branches are covered with short, white, woolly hair, to prevent the evaporation of water from the leaves. They are adapted to the driest and hottest climates, and are without exception alkali plants. Some of the *Kochias* flourish in central Australia, where the day temperatures approach those of Death Valley in southern California. They would be valuable for introduction into southern Arizona and the deserts of southern California as range plants, to supplement the forage supplied by

Franseria, *Allenrolfea*, and other shrubs. An objection to the *Kochias* is that the matted tomentum with which they are covered sometimes forms hair balls or phyto-bezoars in the stomachs of cattle, often causing considerable losses during droughts. But as similar losses occur from the feeding of overripe crimson clover and a variety of other plants, this objection need not be considered a serious one. The *Kochia* saltbushes resemble the winter fat and cottonweed of Texas and the West in appearance, and to some extent also in feeding value, although the latter do not approach them in the matter of seed production.

No. 138. *Kochia americana*. American Gray Bush.

An alkali-resistant, perennial saltbush of a low habit of growth. It is one of the best winter forage plants in the Red Desert of Wyoming.

No. 139. *Kochia eriantha*. Australian Gray Bush.

A saltbush or gray bush from central Australia. Grows where the summer temperature reaches 120° F. in the shade, and the winter temperature falls to 27°. An excellent pasture plant for sheep. (Von Mueller.)

No. 140. *Kochia villosa*. Cotton-bush.

A dwarf, shrubby saltbush growing around alkaline or saline sinks and depressions in central Australia. Resists great extremes of temperature and severe drought. Sheep, camels, and ostriches relish the herbage. Grows from seed or cuttings. Worthy of introduction into the Southwest.

No. 141. *Kuhnistera*. Prairie Clover.

A number of species of prairie clover are common throughout the prairie region and westward into the Rocky Mountains. They are erect perennial legumes, with heads of white or purple flowers and finely divided compound leaves. They are eaten by sheep and cattle green or as part of the prairie hay.

No. 142. *Lactuca scariola*. Wild Lettuce.

A milky-juiced, annual weed, common in the East. The spiny-margined leaves and tender stems are grazed by all kinds of stock. It has been recommended for cultivation as a soiling crop for milch cows. However, its reputation as a bad weed is such that it would be better to use rape or some other crop which does not become a pest in cultivated lands.

No. 143. *Lamium amplexicaule*. Cat's Paw.

An annual or biennial weed with crenate leaves, rather common in waste places and fields from Texas to New England. In Texas it keeps green in winter and is eaten by all kinds of stock.

No. 144. *Lathyrus cicer*. Winter Flat Pea.

A forage plant cultivated to some extent in Germany and Switzerland, and particularly valued because it becomes green earlier in spring than almost any other legume. The seeds are sown at the rate of 2 bushels to the acre. Its appearance is much like the more common flat pea. It reaches a height of 1 or 2 feet.

No. 145. *Lathyrus hirsutus*. Winter Vetch.

Winter vetch was introduced into the United States from Italy, where it is grown quite extensively as a winter soiling crop. It is of value only in the Southern States and has not been found hardy anywhere north of the latitude of Washington, D. C. Winter vetch is very similar in habit and manner of growth to the spring vetches or tares. The trailing vine-like plants grow in dense masses. The stems are narrowly wing-margined; the narrow leaflets are in pairs with a tendril arising between them; the inch-long pods are quite hairy; and the rounded, dark-brownish seeds appear warty under a lens. Winter vetch should

be sown broadcast in August or September at the rate of 2 bushels of vetch and 1 bushel of winter rye or winter oats per acre. If sown in the latter part of August it furnishes a bite of green forage in November and December, at a time when it is particularly desirable, and can be cut for hay in the early spring. Winter vetch sown in February in the Gulf States provides a supply of green forage in April or May. The plant deserves to be more widely cultivated, as it is valuable both as a soiling and a hay crop. It makes its best growth in spring and autumn, when the weather is cool. Winter vetch thrives on any soil which will grow cowpeas, provided that it is not too wet. Its cultivation has been very successful in all portions of the South where it has been tried, and particularly so in central Georgia and Alabama. The winter vetch is desirable as an addition to our list of forage plants, because it lengthens out the soiling season, and furnishes green forage late in autumn and very early in spring, during two periods of scanty vegetation. The crop should be cut for hay when in full bloom. Considerable care is required to get it into the stack or barn without its heating. Any one who can make good cowpea or alfalfa hay can successfully handle this crop.

No. 146. *Lathyrus macrorhizos*. Big-rooted Vetch.

A native of western Asia which would be valuable for introduction into this country. It makes a good growth in the most barren mountainous woodlands.

No. 147. *Lathyrus maritimus*. Beach Pea.

A perennial legume growing on pebbly beaches from Oregon to Alaska. Greedily eaten by cattle. The young peas are cooked green like garden peas. A variety of this is very abundant in Alaska.

No. 148. *Lathyrus myrtifolius*. Myrtle-leaved Vetch.

A vetch with the habit of *Vicia sativa*. It grows in western Oregon and Washington. The scanty forage is eaten by cattle.

No. 149. *Lathyrus ochroleucus*. Yellowish Vetch.

A perennial vetch rather common on the semiarid plains and foothills in Wyoming and the adjoining States. The forage is eaten by cattle.

No. 150. *Lathyrus oregonensis*. Oregon Vetch.

This and a number of other species grow in fire glades in the lodgepole pine forests of Oregon. All are readily eaten by sheep and are excellent fatteners.

No. 151. *Lathyrus ornatus*. Showy Vetch.

This and the variety *incanus* are common in Nebraska and westward. The green pods and peas are used as a vegetable and the plant is grazed by cattle.

No. 152. *Lathyrus polymorphus*. Everlasting Pea.

A low pea, 6 to 12 inches high, with very large purple flowers, common on the prairies from Missouri and Nebraska. It furnishes considerable pasturage.

No. 153. *Lathyrus polyphyllus*. Many-leaved Vetch. (Fig. 14.)

A robust, rank-growing vetch, common on the sands along the coast of Oregon. The pods and coarse forage are eaten by cattle.

No. 154. *Lathyrus pratensis*. Meadow Pea.

A prostrate perennial, native to and cultivated in the colder portions of Europe and Asia. The yield is quite large. It can be utilized for sheep pasturage, the bitter foliage not being relished by other stock. Suited for cultivation in alpine regions. There is danger of "Lathyrism" or poisoning if the seeds or forage of any species of *Lathyrus* are used continuously or in large quantities.

No. 155. *Lathyrus sativus*. Bitter Vetch.

A native of middle and southern Europe, which is adapted to cultivation in cold climates and alpine regions. The fodder is superior to that of vetches, but the yield is scant. In India it is grown as a winter crop, often on heavy, clayey soils which will grow no other legume. It is considered one of the best forage crops in Algeria and hence should be tried in the Southwest. Great caution must be used in feeding the seeds of this plant, as they contain an alkaloid which is said to be poisonous to domestic animals and to man. It has not been cultivated much in this country. Seeds of the bitter vetch have been used for



FIG. 14.—Many-leaved Vetch (*Lathyrus polyphyllus*).

adulterating gram, and there are a number of cases on record where considerable losses of live stock have followed the use of such adulterated feeds.

No. 156. *Lathyrus splendens*. Pride of California.

This vine has been introduced into gardens because of its beautiful flowers. It grows wild in the mountains of southern California, and is said to be an excellent forage plant.

No. 157. *Lathyrus sulphureus*. Sulphur Vetch.

A perennial vetch much resembling the flat pea, but more leafy. Rather common east of the mountains in Washington and Oregon. "A very useful species. The forage is eaten by cattle." (A. B. Leckenby.)

No. 158. *Lathyrus sylvestris wagneri*. Flat pea.¹

A perennial, native of eastern Europe and northern Asia, which has of recent years been highly recommended as a forage plant on account of its drought-resisting qualities. The plant looks much like the ornamental sweet pea, with many weak, leafy stems which interlace in great tangled masses. The handsome rose-colored flowers are borne in loose clusters, and are followed by pods not unlike those of the field pea. Analyses of the hay, made at the Michigan Station, showed 27 per cent crude protein. The growth of the plant at first is slow and it is recommended to plant the seed in beds, from which they may be transplanted at the beginning of the second season to the place they are to occupy in the field. Several cuttings may be taken each season in favorable localities, and the average life of a field is from fifteen to twenty-five years. In this country the best results have been obtained with the flat pea in California, in the arid Southwest, and in the Southern States. The flat pea has now been grown experimentally in every State in the Union. As a rule the verdict in regard to it is that the flat pea is not as valuable as at first claimed. Stock do not relish the green plant. Some Experiment Stations have even reported that cattle reject the hay. Careful experiments made to determine its feeding value indicate that at least a part of the large amount of nitrogen present is in a form or combination not available for food, so that the forage does not have as high a value as indicated by its chemical analyses.

No. 159. *Lathyrus venosus*. Woodland Pea.

A perennial woodland vetch quite common in the Eastern States. The vines often grow 8 to 10 or more feet long. Cattle are fond of the plant. It is one of the most valuable of the woodland legumes.

No. 160. *Lavateria arborea*. Tree Mallow.

A tall, rapidly growing, biennial plant, native of the seacoasts of southern Europe. The forage is quite valuable.

No. 161. *Lavatera assurgentifolia*. Lavatera.

A shrubby, branching mallow 6 to 15 feet high, with hairy stems, long-stalked, five- to seven-angled leaves 3 to 6 inches wide, and large rose-red and crimson flowers on long downwardly curving flower stalks. A native of the islands off the coast of southern California, which has long been cultivated as a forage plant around San Francisco. It has become established there on the sand dunes and along the seashore. The mucilaginous leaves are eaten by stock.

No. 162. *Lepidium lasiocarpum*. Peppergrass.

An annual weed with hairy stems and rough finely-cut leaves. Quite common in the arid Southwest. Sheep are very fond of it in early summer.

No. 163. *Lespedeza bicolor intermedia*. Hagy.

A perennial, bushy lespedeza from Japan, with the habit of alfalfa, but more woody. Hagy has been grown at the North Carolina and Mississippi experiment stations. It is considered to have some value as a pasture plant, especially for sheep, but for hay it is inferior to alfalfa in yield and quality.

No. 164. *Lespedeza capitata*. Round-headed Bush Clover.

A bush clover with rigid woolly stems, short leaf stalks, oblong leaflets smooth above and silky below, and flowers in rounded clusters. Common in dry and sandy soil from New England to Florida and westward to the prairies. It is a good pasture plant.

¹ For further remarks on the Flat Pea see Circular No. 11 Division of Agrostology.

No. 165. *Lespedeza cyrtobotrya*. Bush Lespedeza.

A shrubby Japanese perennial fodder plant 6 to 10 feet high, which, although quite nutritious and containing about 16 per cent of crude protein, has not been considered worthy of further cultivation in the South. (Tracy.)

No. 166. *Lespedeza polystachya*. Hairy Bush Clover.

An upright wand-like plant 2 to 4 feet high, growing on dry hills and barrens in the Eastern United States, and valuable as a pasture plant.

No. 167. *Lespedeza procumbens*. Creeping Bush Clover.

A slender trailing prostrate plant, common in dry, sandy soils throughout the Eastern United States, of some value as a pasture plant.

No. 168. *Lespedeza striata*. Japan Clover. (Fig. 15.)

An annual legume, native of Eastern Asia, which was accidentally introduced into the South about forty or fifty years ago, and has now become naturalized as far west as Texas. It will grow on worn fields and sterile or exhausted soils, spreading rapidly over the surface, preventing further washing of the land. In such localities it grows prostrate on the surface, forming a dense mat of turf. In rich soils, especially such as are calcareous, it grows 20 or 30 inches high, and when mown makes an excellent quality of hay, greedily eaten by all kinds of stock. It is distinctively a summer forage, appearing about the 1st of June and dying down at the first touch of frost. In sandy soils it suffers greatly from hot weather. The roots penetrate deeply into the soil, and in common with most other leguminous plants, Japan clover, by means of the tubercles on its roots, collects nitrogen from the air, so that it is one of the best crops to turn under; as green manure it is especially useful in renovating old fields. The feeding value is fair, but less than that of clover and cowpeas. Seed should be sown broadcast at the rate of half a bushel to the acre, either in autumn with oats or winter rye, or alone in spring. Clean seeds are not to be had in the markets.



FIG. 15.—Young plants of Japan Clover (*Lespedeza striata*).

No. 169. *Lespedeza violacea*. Purple Bush Clover.

A bush clover with upright or spreading branching stems, whitish downy leaflets, purple flowers, and ovate pods. Common in the Eastern United States, and contributing a small amount of forage in woodland pastures. There are many other species of native American bush clovers which are hardy and nutritious, and which occur in considerable quantity in woodland pastures and open prairies. All are eaten, at least when young, by sheep and cattle.

No. 170. *Lespedeza virginica*. Virginia Bush Clover.

One of the best native legumes in Southern woods and pastures. It comes up early in spring and is sought out by cattle, which seem quite fond of it.

No. 171. *Lesquerella gordonii*. *Lesquerella*.

A yellow-flowered crucifer which appears early in spring and is much sought after by sheep on the Southwestern ranges.

No. 172. *Lippia ligustrina*. *Lippia*.

A spiny shrub 3 to 10 feet high. Leaves pale green, 1 inch or less long; flowers white, very fragrant. The leaves and twigs are eaten by cattle. Grows on rocky slopes in Texas. (Havard.)

No. 173. *Lippia nodiflora*. False Verbena.

A creeping or low, perennial herb with gray-green, cuneate, sessile leaves and rose-colored flowers. Bentley states that this is a promising hay plant for the semiarid Southwest. It is extensively used for lawns in the Tropics.

No. 174. *Lotus americanus*. Dakota Vetch. (Fig. 16.)

Botanically related to the bird's-foot trefoil and the square-pod pea, which are useful European species. It grows throughout the northern prairie region from Kansas to Montana, and is abundant on the Pacific coast. Ranchmen in the Upper Missouri Valley consider the Dakota Vetch one of the best forage plants on the range. Where it is abundant, cattle are sure to get fat. It has been cultivated to some extent on plowed lands. It is quite a common practice to save the chaff that collects in the hay-baling machines and in the wagon beds when hauling hay to the balers. This chaff, containing often considerable quantities of seed, is scattered over the bottom lands in the valleys to further increase the amount of vetch in the hay. Analyses of South Dakota grown hay, consisting entirely of this vetch, gave 17.6 pounds of crude protein in each hundredweight of hay. The per cent digestible has not been determined, but it is undoubtedly high, as cattle become "seal fat" where Dakota Vetch is abundant. The Dakota Vetch seeds freely in good seasons. In times of drought or shortage stock eat it down closely and prevent its ripening seed. Hence, the stand on the open range varies greatly, depending on the abundance or scarcity of other feed. This vetch often grows 2 to 3 feet high in good soils and seasons,



FIG. 16.—Dakota Vetch (*Lotus americanus*).

or may not be more than a few inches high during dry seasons or on sterile soils, but it roots deeply and is well adapted to its native prairies. The seed may be had for the gathering, and need not cost any more than clover or alfalfa, if the trouble is taken to run the chaff through a fanning mill.

No. 175. *Lotus corniculatus*. Birdsfoot Clover.

A low, prostrate clover that will grow on the lightest and most sterile soils. It is an Old World plant, with wide distribution, and has become extensively naturalized in this country, especially in the South. Cattle and sheep are fond of it. Because of its deep roots it withstands drought, and is an excellent clover to sow in mixtures with taller growing species in dry pastures. It is particularly valuable in such places because the herbage has a salty taste and is welcome in hay.

No. 176. *Lotus glaber*. Deerweed.

This bush or weedy herb is a native of the mesas, mountains, and desert of southern California. It grows 2 or 3 feet high on the driest and most sterile soils, and is an excellent forage plant. It sometimes occurs in such abundance that it is cut for hay. As it ripens a large amount of seed each year this is a promising species for trial on the arid cattle ranges of the Southwest.

No. 177. *Lotus macranthus*. Yellow Lotus.

A yellow-flowered clover with many small leaves and tender stems. It grows on poor, dry soils in eastern Oregon and Washington. The forage is quite valuable.

No. 178. *Lotus tetragonolobus*. Square-pod Pea.

A much-branched ascending annual, closely related to the birdsfoot clover. It is native of southern Europe, and is there grown for salads and as an ornamental plant. It has been recommended by the California Experiment Station as one of the best winter crops for plowing under in spring as green manure. It yields from 20 to 25 tons of green fodder, equivalent to 4 or 5 tons of air-dried hay, and the roots are described as being fairly incrustated with nitrogen tubercles. The plant does not contain as high a percentage of crude protein as alfalfa or the clovers, but is worth two or three times as much as either as a green manure because of the enormous amount of herbage produced. Sown in January, it will be ready to be plowed under in May. The seed should be thinly broadcasted on freshly plowed land and harrowed in.



FIG. 17.—White Lupine (*Lupinus albus*).

No. 179. *Lotus uliginosus*. Swamp Horn Clover.

This is a slender, branching clover with heads of rather large, yellow flowers and slender, elongated pods. It is a native of northern Europe, where it is esteemed for swampy meadow lands. It is now cultivated in Wisconsin and Minnesota on sour, peaty, or muck soils.

No. 180. *Lupinus albus*. White Lupine. (Fig. 17.)

An annual, native to the Mediterranean region, which is widely grown in Europe, and to a less extent in this country, for green manure. On rich soil it grows from 2 to 3 feet high, and is recommended as a crop to plant for the purpose of enriching the ground, and at the same time freeing it from weeds. It has a deep taproot well supplied with tubercles, which gather large amounts of nitrogen from the air. It yields good forage while young, but should not be fed after the flowers appear. The seeds contain a bitter alkaloid. After this has been removed by soaking or boiling the seeds are sometimes used as food.

No. 181. *Lupinus arboreus*. Sand Lupine.

A Californian lupine useful for binding drifting sands. Grows rapidly on the coastal dunes, covering them with a dense mass of vegetation in less than a year. Of some forage value, and probably useful as a green manure on sandy soils.

No. 182. *Lupinus hirsutus*. Blue Lupine.

The blue lupine is an annual, much resembling *L. albus* in value and habit of growth. Its only use is for turning under as green manure.

No. 183. *Lupinus laxiflorus*. Lupine.

A common and important sheep forage in the Cascade Mountains of Oregon.

No. 184. *Lupinus luteus*. Yellow Lupine.

This annual species is the most generally used in middle Europe to improve sandy soil. It grows well even on sand dunes along the coast. Like the other lupines it can be fed green or as hay. The seeds of this species are very fattening when

used as an addition to hay, and are in this respect quite equal to oil cake, while the foliage is said to be not inferior to that of clover, and more bulky. Ninety pounds of seed are required per acre. It should be sown in the spring as soon as the ground is warm. It attains maturity very rapidly. Lupines, unlike most other leguminous plants, do not do well on calcareous soil nor on ground which is at all wet, but for improving sandy fields they have few equals. There are about 90 species of lupines native of the United States, principally in the Rocky Mountain and Pacific coast regions, and many of them have acquired local reputation as being good pasture plants, particularly those that grow in the arid Southwest. One of our species, *L. perennis*, which is common to this country and the Old World, is cultivated as an ornamental

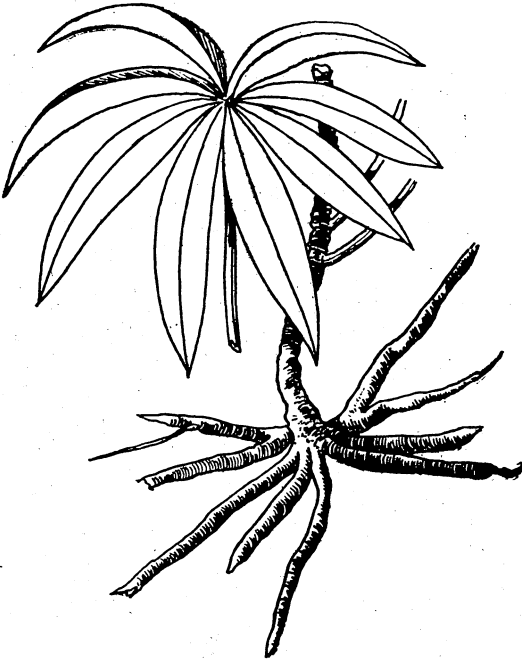


FIG. 18.—Cassava (*Manihot aipi*).

plant in gardens, and has been recommended by German agriculturists as equal in value to white lupine for certain dry soils.

No. 185. *Lupinus nootkensis*. Blue Lupine.

A perennial bushy lupine 3 to 4 feet high with broad leaves, springing from a large taproot like a parsnip. It grows in old wornout fields in the Pribilof Islands. Besides having been introduced into cultivation as an ornamental garden plant it has some value as a soil renovator. The root has medicinal properties.

No. 186. *Lupinus rivularis*. Ten-finger.

A common lupine in the Cascade Mountains of Oregon. The forage is eagerly eaten by sheep.

No. 187. *Lupinus subcarnosus*. Fleshy Lupine.

A rather stout, silky perennial with palmately five-parted leaves and racemes of purple flowers. It grows in southern and western Texas, appearing early in spring, at which time both sheep and cattle graze it down. The seeds are

ripened abundantly. The fleshy lupine or buffalo pea was formerly common, but has now about disappeared except where protected from stock. It is said to have been often cut for hay in the early days. A promising species for trial in cultivation.

No. 188. *Madia sativa*. Tarweed.

A rank-growing annual, native to both Chile and California, which has been recommended as an excellent summer forage for sheep. The leaves are clammy with viscid exudation, and the plant has a rank odor. Its chief merit is its rapid growth. It has been cultivated in the arid Southwest and California. An excellent lubricating oil is extracted from the seeds.

No. 189. *Manihot aipi*. Cassava. (Fig. 18.)

A spurge, native of the Tropics, largely cultivated in the West Indies, Central and South America, and to a less extent in Florida and California. It is a rapid grower, with rank, branching, erect stems 4 or 5 feet high, large, seven-parted, long-stalked leaves, and horizontal fleshy roots or tubers 3 to 5 feet long and from 1 to 2½ inches in diameter. It thrives in loose, dry, sandy loams, and produces from 6,000 to 8,000 pounds of roots per acre on soils of average fertility, and 10,000 to 20,000 pounds on fields that have received large amounts of fertilizers. The roots are fed whole or sliced, to all kinds of stock. They contain 72 per cent of starch, 17 per cent sugar and gum, and over 3 per cent of albuminoids. On account of the small amount of flesh formers contained in the roots, they should be fed with some nitrogenous food to make up the deficiency. Cassava is propagated by means of cuttings of the stems, each piece having two or three eyes or buds. These are planted in hills 4 feet apart each way, and the rows rolled, to pack the earth around the cuttings and prevent their drying out. The roots should be dug only as fast as they can be used, as they rot quickly when exposed to the air. Cassava is now extensively grown in Florida for the manufacture of starch.

No. 190. *Manihot utilisima*. Bitter Cassava.

One of the best-known plants in tropical agriculture. There are thirty or more cultivated varieties of the bitter cassava in Brazil. The roots of some varieties are harmless; others contain the volatile prussic acid, a deadly poison. This is removed by heating or cooking. The yell wish roots do not boil soft like the reddish roots of *M. aipi*. The roots are often very large (2 to 3 feet long), weighing sometimes 100 pounds or more. Cassava is the source of tapioca, which is manufactured by heating the moist starch. It might well be introduced into Florida.

No. 191. *Medicago arborea*. Tree Lucern.

A perennial yellow-flowered shrubby alfalfa, valuable both as a bee plant and for forage. Now growing wild in Greece. Tree lucern has been cultivated over two thousand years. It was much esteemed by the ancient Greeks and Romans, being called "Cytisus," and was extensively used for forage.

No. 192. *Medicago denticulata*. Bur Clover. (Fig. 19.)

An annual clover, native of the Mediterranean region, which has become naturalized in most warm countries. It was early introduced into California, and has become widely distributed in that State and in the grazing regions of the Southwest. It is not as nutritious nor as palatable as either alfalfa or clover, but fills in the season when other more important forage plants have become dried up by the summer heat. Stock of all kinds fatten upon the burs, which they pick from the plant while it is growing, and search for on the ground after the foliage has become completely dry and dead. It flourishes best in moist valleys and along the coast where there is abundant rain, from January to June. It also occurs on the drier uplands back from the coast, but does not do so well in such locali-

ties. One of its disadvantages is that its prickly burs become entangled in the wool of sheep. It has become widely disseminated over the ranges, and adds much to the value of the summer pasturage. To establish a crop of this clover, the burs may be scattered broadcast in autumn. They will grow as soon as the winter rains come. They may be harrowed or cultivated in the early spring.

No. 193. *Medicago falcata*. Yellow Lucern.

A close relative of alfalfa, much resembling it, but smaller, and with yellow flowers. It grows wild in northern Europe, along roadsides and fence corners, in light or sterile soils. It has been cultivated to some extent, but is without value, except that it furnishes a scanty pasturage on soils too barren for better and ranker-



FIG. 19.—Bur Clover (*Medicago denticulata*).



FIG. 20.—Black Medick (*Medicago lupulina*).

growing species. It is even more susceptible than alfalfa to excess of water in the soil.

No. 194. *Medicago lupulina*. Black Medick. (Fig. 20.)

An annual or biennial, widely grown as a pasture plant in wet meadows and on stiff, clayey soils which are too poor to grow alfalfa or clover. It is sometimes recommended to be sown mixed with white clover for lawns, as it remains green during the driest summers. The chief use to which black medick is put is to adulterate red-clover seed. Red-clover seed imported into this country sometimes consists of 50 per cent or more of *Medicago lupulina*.

No. 195. *Medicago maculata*. Bur Clover.

An Old World pasture plant, which has become widely introduced in the Eastern and Southern States, as far west as Texas. It is very similar to *M. denticulata* in appearance and feeding value, and is often mistaken for the latter. Both species occur in the South, and both are called bur clover. It makes a rank



FIG. 1.—ALFALFA, BELLEFOURCHE, SOUTH DAKOTA, 1897.



FIG. 2.—HAIRY VETCH GROWN IN GRASS GARDEN, U. S. DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

growth, often in rich soil attaining a height of 3 or 4 feet. Its principal value is in pastures. Its burs are fattening when once stock have acquired a taste for them. Bur clover is said to be a bad weed in sheep pastures. The burs cling to the fleeces, and the fragments of hooked spines can not be separated from the wool. When present in any quantity the burs decrease the selling price of the wool.

No. 196. *Medicago orbicularis*. Round Snail Clover.

Very similar to *M. rugosa*, and, like it, worthy of extensive introduction on the semiarid ranges to supply pasturage for sheep and cattle.

No. 197. *Medicago rugosa*. Smooth Snail Clover.

A "bur clover" with smooth burs, native of the Mediterranean region. This and other smooth-podded sorts should be used for sheep pastures instead of *M. denticulata* and *M. maculata*, because of the injury to wool caused by the latter.

No. 198. *Medicago sativa*. Alfalfa; Lucern. (Plate II, fig. 1; and fig. 21.)

Alfalfa is one of the best known and most extensively grown forage plants of the United States. It is the best hay and soiling crop in the West, and is being rapidly introduced into the Southern and Eastern States. It is an upright, branching, smooth, perennial, 1 to 3 feet high, with three-parted leaves, each leaflet broadest above the middle. The purple flowers are in long, loose clusters or racemes. The ripe pods are spirally twisted, and each contains several seeds. Alfalfa is a deep feeder, drawing most heavily on lime, potash, magnesium, and phosphoric acid. The taproot descends to a great depth wherever the soil is loose and permeable, often averaging 10 to 15 feet wide, while extraordinary depths of 50 or 60 feet have been recorded. It will grow in favorable soil anywhere from sea level up to 7,000 feet elevation, and the success or failure of the crop depends as much upon the character of the subsoil as upon the surface layers. Good drainage is necessary, as the plants are killed by excess of water in the soil or on the surface. Thorough preparation of the seed bed is the first essential. Plow deeply and subsoil deeply, and before planting the seed work the field until it is mellow. Seed should be sown broadcast in amounts of from 8 to 25 pounds per acre, according to whether seed or hay is desired, as soon as the ground is warm and there is no further danger from frost. Cover the seed very lightly. If sown broadcast, a light harrow or brush will be sufficient; or, if there is rain immediately after sowing, no harrowing will be



FIG. 21.—Alfalfa (*Medicago sativa*): a, b, seed pod; c, seed.

necessary. The field selected should be free from weeds, and the alfalfa should be sown without any nurse crop, as the young plants are tender and easily choked out by a nurse crop or a rank growth of weeds. A crop may be cut as soon as it has attained the height of 15 to 18 inches. The second and following crops should be cut when the plant is coming into bloom, as at that period it contains the highest amount of digestible food. A heavier yield may be obtained by waiting, as many do, until the pods commence to form, but the stalks are then woody and less palatable, and there will be more waste in feeding than if cut when in early bloom. Considerable care is necessary in curing to prevent heating, and especially to prevent the loss of leaves. The best practice is to cure in cocks. Stacks of alfalfa will not turn water unless they are topped off with marsh or prairie hay, or covered with hay caps. One hundred pounds of freshly cut alfalfa contain at time of flowering 28.2 pounds of dry matter,¹ and of this the amount digestible is 3.8 pounds of crude protein, 11.2 pounds of carbohydrates, and 0.41 pound of fat, so that the nutritive ratio is 1 to 3.1. One hundred pounds of alfalfa hay contain the following digestible constituents: 10.58 pounds of crude protein, 37.33 pounds of carbohydrates, and 1.38 pounds of fat, with a nutritive ratio of 1 to 3.8. At the Massachusetts Experiment Station 1,000 pounds of the dry substance of alfalfa hay was found to contain 81.1 pounds ash, 16.5 pounds crude fat, 760.2 pounds carbohydrates, and 142.2 pounds crude protein. The fertilizing value of 1,000 pounds of dry matter is 22.75 pounds of nitrogen, 5.61 pounds of phosphoric acid, and 16.53 pounds of potash. In Colorado 1,000 pounds of alfalfa hay were found to contain 22 pounds of nitrogen, 4.14 pounds of phosphoric acid, 25.48 pounds of potash, and 20 pounds of lime, and during one year three crops amounting to 3.8 tons per acre contained 167 pounds of nitrogen, 31 pounds of phosphoric acid, 194 pounds of potash, and 152 pounds of lime. In Kentucky the analyses of freshly cut alfalfa showed 4.22 per cent of crude protein, 0.81 per cent of crude fat, 10.9 per cent of carbohydrates, and 2.14 per cent of ash. Thus it will be seen that the composition varies somewhat in different portions of the country. This diversity in composition may result from such causes as differences in development or variation in the amount of available plant food in the soil. Alfalfa hay is much richer than clover hay, containing for every 100 pounds 54.5 pounds of digestible substances, of which about 11 pounds are protein. The relation of crude protein of alfalfa hay to that of red clover is as 11 to 7. Altogether, alfalfa is one of the best forage crops grown in the United States, and is adapted to cultivation in a greater range of latitude than red clover. It has succeeded as far north as central New York, southern Michigan and Montana, and as far south as southern California, Louisiana, and Florida—a wider range than that of any other of our forage plants except Indian corn.²

No. 199. *Medicago scutellata*. Snail Clover.

A pasture plant suitable for introduction on the ranges of the Southwest. Cattle and sheep eat the pods during the summer. Fully equal to bur clover in feeding value and superior to it in having smooth pods which do not injure the wool. As many as 350 pods each containing four or five seeds are sometimes borne on a single plant.

No. 200. *Medicago tuberculata*. Annual Snail Clover.

An annual herb which, according to Baron von Mueller, is valuable for pasture lands as its fruits, although somewhat rough, never become spiny, and do not injure the fleeces of sheep. It would be a good plant to use on sheep runs instead of bur clover.

¹ Appendix to Yearbook of the Department of Agriculture for 1896.

² For further remarks on alfalfa see Farmer's Bulletin No. 31 and Circular No. 25, Division of Agrostology.

No. 201. *Medicago turbinata*. Snail Clover.

This resembles *M. tuberculata*, and has been recommended by the California Experiment Station for the same purpose. Its pods are liable to become spiny when the plant is grown in rich soil (Von Mueller). It is an excellent winter forage plant in California, the yield of tops and burs being larger than with the ordinary bur clover.

No. 202. *Melilotus alba*. Sweet Clover; Bokhara Clover.

This is a weedy biennial, concerning which extravagant claims have been made. It is chiefly valuable in the Southern States for early pasturage and for green manure. The long taproots descend deeply into the soil, and when the crop is turned under, a very large amount of available plant food is left for the benefit of succeeding crops. Because of its strong odor, stock will not eat it until they have acquired the taste, but if they are turned into a field of sweet clover in early spring, before the other clovers have commenced to come up, they will quickly learn to eat it. The seed should be sown alone in August, or in February, at the rate of half a bushel to the acre. If sown in spring, a crop may be cut in autumn, and two or three crops the second season. It ought never be allowed to go to seed. Sweet clover is a good green manuring crop to use in bringing up the value of old fields and barren or washed surfaces where a large bulk of nitrogenous organic matter is desired. It has an advantage over the other legumes in being able to grow on hard, poorly cultivated soils. On lands that are at all rich, cowpeas, velvet bean, beggar weed, or crimson clover ought to be grown instead of sweet clover in order to secure the full feeding value as well as the fertilizing value of the crop. Sweet clover is sometimes used as a preliminary fertilizer crop in preparing "filled in" lots or "made" land in city parks for lawns, because of its great bulk of stems and leaves the second year.

No. 203. *Melilotus dentatus*. Russian Melilot.

A biennial native of southern Russia. This is less odorous than sweet clover and is more valuable as a forage plant on that account. Like *M. alba* this species grows well on saline and alkaline soils.

No. 204. *Melilotus indica*. Yellow Sweet Clover.

A yellow-flowered, strong-scented melilot, widely spread on the Pacific slope, occurring as a weed in grain fields. Opinions differ as to its value as a forage plant, some esteeming it highly, but its bad qualities as a weed probably overbalance any good it may possess.

No. 205. *Melilotus linearis*. Hungarian Melilot.

A biennial sweet clover which is productive and succeeds in poor land, but especially on such as are fertile and humid, along streams and rivers. Twenty-two pounds of seed are sown per acre. The quality of the forage is contested. (Vilmorin.)

No. 206. *Melilotus officinalis*. Yellow Sweet Clover.

This European species has become quite widely naturalized in this country. It possesses little value—not enough to warrant its cultivation. It grows in swamps and in wet meadows.

No. 207. *Mesembryanthemum edule*. Hottentot Fig.

A spreading plant with fleshy foliage, adapted to introduction as a forage plant in the Mohave and Colorado deserts. It is a native of the Kalahari Desert in South Africa. Professor MacOwan says that a stretch of land covered with *Mesembryanthemum* is as good as a pond of water. There is one species, *M. æquilaterale*, in the Santa Catalina Islands. These plants thrive along seacoasts and in the driest sandy deserts, withstanding extremely high temperatures.

No. 208. *Modiola decumbens*. Modiola.

A prostrate, creeping, weedy, annual mallow, native of Chile, which has been introduced into portions of California, and is recommended by the California Experiment Station as an alkali plant. Analyses made of it show that it contains almost as much crude protein as alfalfa. Sheep and cattle are fond of it, and eat it down closely. Because it roots freely at the joints, it is, like purslane, difficult to eradicate, and should be introduced with some caution. A closely related species of very similar habit, *M. multifida*, is a native of low grounds from Virginia southward. This is also valuable as a pasture plant.

No. 209. *Mollugo verticillata*. Fall Purslane.

An annual. Very abundant in southern New Mexico. Fine forage for sheep and cattle. "Covers the ground like a carpet from September until frost." (J. K. Metcalfe.)



FIG. 22.—Velvet Bean (*Mucuna utilis*), showing leaves, flowers, and young pods.

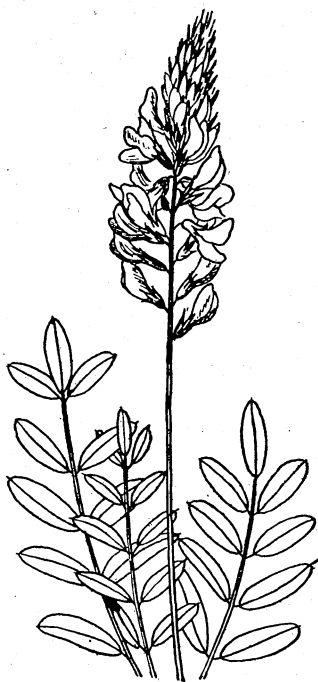
No. 210. *Mucuna utilis*. Velvet Bean. (Plate I, fig. 1; and fig. 22.)

Velvet bean has been tried extensively in the Southern States. It has about the same feeding and fertilizing value as the cowpea, and the yield of vines is about the same in tons per acre, although of greater bulk. The seed crop ranges from 15 to 25 bushels per acre. It is an excellent mulch crop in orchards. The vines contain a considerable amount of crude protein and are valuable for forage and green manure. The velvet bean is adapted to cultivation in Florida and along the Gulf coast.¹

¹ For further remarks on Velvet Bean see Circular No. 14, Division of Agrostology.

No. 211. *Onobrychis sativa*. Sainfoin. (Fig. 23.)

A deep-rooting, perennial legume, extensively cultivated in the temperate portions of Europe on dry, calcareous soils which are too barren for clover or alfalfa. The stems are erect or ascending, 1 to 2 feet high, ribbed and downy, the leaves unequally pinnate, composed of 6 to 12 pairs of opposite leaflets, with an odd terminal one. The bright pink flowers are numerous in spike-like racemes, borne on a long stalk. A permeable, well-drained subsoil is essential for its growth. Like alfalfa, it is quickly killed whenever the ground becomes saturated with water, and is therefore not suited for growth in wet meadows or in marshy lands. There is no better plant for growing on barren hills, but it does better on the sunny slopes than on those facing north. It is rather difficult to establish, as the plants are easily killed when young, but when once well rooted, sainfoin will live from twenty to twenty-five or sometimes a hundred years, provided the soil is rich enough. One crop of hay can be cut each year. It should be cut at the time of full bloom, which in the latitude of Washington, D. C., is about the 1st of May. In England the average yield ranges from $1\frac{1}{2}$ to $2\frac{1}{2}$ tons per acre, and the hay is better and more nutritious than that of red clover. Eighty pounds of seed should be sown per acre, any time from the middle of May to the end of June, and, unlike alfalfa, it should be covered quite deeply to insure germination. If shelled seed is to be had, half as much will suffice. Fresh seed must always be used, as it loses its vitality if kept a year. It can be grown in any part of the United States, and should be more extensively cultivated, especially in localities where the ground is too dry or too barren for red clover. The yield of seed ranges from 10 to 25 bushels of 40 pounds. Sainfoin should not be pastured closely, as it does not have the same recuperative ability as the clovers. It resembles alfalfa, but is not so rapid a grower and does not yield as heavily. Sainfoin is one of the best bee plants, producing a large amount of first quality honey. It should be more largely cultivated for this reason if for no other. A small amount of seed was distributed by the Section of Seed and Plant Introduction in 1899, mostly through the Southern States. Experiments conducted at the Wyoming Experiment Station indicate that sainfoin is valuable as a range forage plant, as it makes a strong growth on the unbroken sod.

FIG. 23.—Sainfoin (*Onobrychis sativa*).**No. 212. *Opuntia engelmanni*. Prickly Pear. (Fig. 24.)**

A species of flat-jointed cactus common in central and southern Texas. The stems are mucilaginous and watery, and in times of drought serve to some extent as food, or, more especially, as water. Cattle and sheep may be kept alive for several months on prickly pear alone. Where the stockman makes no provision for bad seasons, prickly pear is evidently a good thing. But every man ought to dig wells, build tanks, and save hay or stack silage during the good seasons to tide over the bad ones. Viewed from this standpoint the prickly pear is

not a success. It spreads very rapidly, forming dense thickets, encumbering the land and driving out the best grasses. Cattle do not eat it, except the ripe fruits, as long as there is anything else to satisfy their wants. It is only valuable as an emergency ration. Before feeding, the spines must be destroyed either by burning or boiling. Professor Toumey states that cattle die in great numbers in southern Arizona during times of drought as a direct result of feeding on cactus. The spines pierce their mouths and work through the walls of the stomach and intestines, even penetrating the muscles and eventually causing the death of the animal. It is a common sight in the cactus-infested pastures of southern Texas to see cattle with their flanks looking like pinecushions, thickly covered with the long yellow spines of the prickly pear. There are

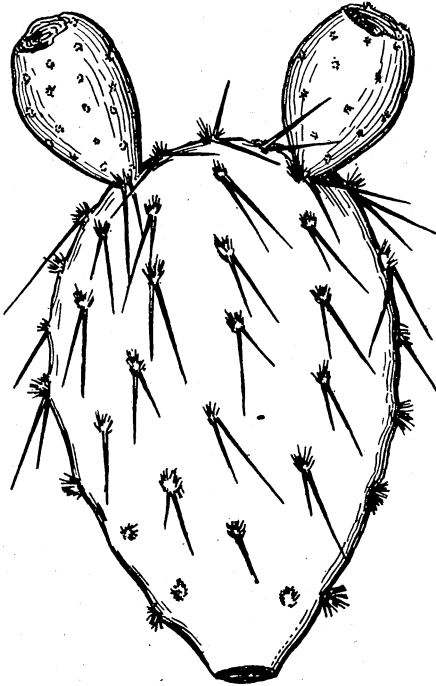


FIG. 24.—Prickly pear (*Opuntia engelmanni*).



FIG. 25.—Serradella (*Ornithopus sativus*).

many more desirable forage plants than this cactus, and it is probably on the whole more of a curse than a blessing.

No. 212 a. *Opuntia ficus-indica inermis*. Spineless cactus.

This "prickly pear" cactus without spines or prickles is extensively grown in Sicily and northern Africa for forage. Dr. Trabut, government botanist of Algeria, considers it extremely valuable, especially when used in combination with alfalfa, fenugreek, sulla, and the scarlet vetch. There are extensive plantations of this cactus in Algeria. It might be introduced with profit into Florida, southern Arizona, and southern California.

No. 213. *Ornithopus sativus*. Serradella. (Fig. 25.)

An annual legume, native of southern Europe and northern Africa, which is valuable as a fodder plant on moist and sandy sterile soils. At the Pennsylvania Station the yield from two cuttings was $11\frac{1}{2}$ tons of green forage. It does not

require lime, and is often used as a green manure to bring up the value of sterile fields. The forage, which is much relished by cattle and sheep, has about the same feeding value as red clover, but the yield is usually much less.

No. 214. *Pachyrrhizus angulatus*. Yam Bean.

A perennial, leguminous vine, native of Central America. The horizontal, starchy roots grow to be 5 to 8 feet in length and often weigh 70 pounds. Requires a rich soil. (Von Mueller.) Suitable for introduction into Florida as a forage plant for hogs. It is cultivated as a garden vegetable in the Philippines. The nearly related *P. tuberosus* from Venezuela is of equal value.

No. 215. *Pentzia virgata*. African Tansy.

A South African tansy bush, which is highly valued as sheep forage in semiarid regions. Broken branches or twigs take root lying on the ground, so that the plant spreads with great rapidity, especially along water courses.

No. 216. *Peteria scoparia*. Camote del monte.

A low, shrubby legume 2 to 3 feet high, rather abundant in the mountains west of the Pecos River. It has small, edible tubers which are eaten by hogs.

No. 217. *Phaseolus diversifolius*. Creeping Kidney Bean.

An annual, with prostrate, spreading leafy stems, common on the prairies and cedar glades of the Southern States. The foliage is eaten by cattle and sheep.

No. 218. *Phaseolus helvolus*. Wild Bean.

A climbing perennial bean with trifoliate leaves and numerous clusters of straight four- to eight-seeded pods. It grows in woodlands and along streams from New York to Texas. Cattle and sheep eat both foliage and pods wherever they grow within reach. The forage approaches that of the cowpea in feeding value. Like other legumes, the roots are well supplied with nitrogen-gathering tubercles and the plant contains quite a large percentage of crude protein. A variety of this plant has been cultivated at the Louisiana Experiment Station under the name of St. Helena pea, and is quite highly recommended as a profitable crop for hay or green manure. The species is a very variable one and is one of the most promising for experimental purposes, because of its wide adaptability to varying soil and climatic conditions.

No. 219. *Phaseolus mungo*. Green Gram.

A bean which has been cultivated in India for three thousand years for food and forage. There are many varieties with green, yellow, and black seeds. Grown usually as a summer crop like the cowpea, but there are winter varieties also. Both forage and seeds are relished by cattle and prove fattening. Green gram has been grown at the Louisiana Experiment Station, where it was held to be of less value than the cowpea. However, more extended trials with seed of the different varieties might be profitably made.

No. 220. *Phaseolus mungo radiatus*. Indian Bean.

A variety of the preceding which is said to be the best of all the beans cultivated in India. There are forms with both green and black seeds. The variety *radiatus* has yellowish green leaves, while those of the *P. mungo* are dark green. The seeds contain 22.7 per cent of crude protein and are valuable for fattening cattle. It deserves a trial in the South.

No. 221. *Phaseolus perennis*. Everlasting Bean.

A species closely related to the garden bean, widely distributed in the Eastern and Southern States. It grows in woodland copses and along the banks of streams, and wherever found is eaten greedily by stock.

No. 222. *Phaseolus retusus*. Metcalfe Bean. (Figs. 26, 27, 28.)

One of the most valuable groups of American Leguminosæ is that of the wild beans which are botanically closely allied to the common garden beans. In the Southwest there is a great variety of wild beans. They are scattered through every mountain canyon, on wooded slopes, and through the little parks along the streams. Formerly they were much more abundant, but are now relegated to cliffs and canyon walls, inaccessible to sheep and cattle, or to dry valleys, far from living water. In the mountains between the Rio Grande and the Gila the wild beans formerly supplied a great amount of feed for deer and cattle. Wherever there were wild beans cattle became fat. One of the best of these wild sorts is the Metcalfe bean. This bean and all of its near relatives are perennials. They develop enormous fleshy roots that are often 4 to 6 inches in diameter and weigh 30 pounds or more. The top of this fleshy root (fig. 28) is usually 6 or 8 inches below the surface, so that the ground may be plowed or given a shallow cultivation without destroying the beans. The vines grow out in every direction from the crown much like sweet potato vines, varying from 6 to 10 or even 20 feet in length at the end of the first season. The racemes of scattered pink flowers (fig. 27) appear from July to September, and the pods and seeds (fig. 26) ripen freely

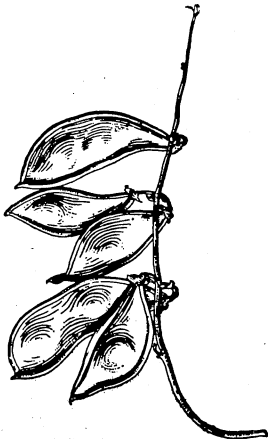


FIG. 26.—Ripe pods of the Metcalfe bean (*Phaseolus retusus*).

in cultivation. All perennials which grow in semiarid and desert regions have some especial adaptation for preventing the loss of water. These may include modifications of the protective surfaces of leaves and stems, such as thickening of the epidermis, the development of a dense covering of hair, or it may consist, as in this case, of an enlargement of the stems or roots, thus providing reservoirs in which water and plant food may be stored up during the season of growth for use during periods of drought or scarcity of water and food. Because of this special modification the wild beans ought to be of great importance and value in Southwestern agriculture. As drought-resistant crops they should be much superior to any forage plant which has not this fleshy perennial root. The Metcalfe bean is one of the most promising of our native forage plants. The amount of forage which it produces is naturally large, but it also shows a tendency to improve in quality and quantity with cultivation. There is constant and growing demand for drought-resistant forage crops in the West and Southwest, and the cultivation of those leguminous forage plants that show an adaptation to natural conditions is an exceedingly promising line of work.



FIG. 27.—Flower cluster and leaf of the Metcalfe bean.

No. 223. *Phaseolus semierectus*. Phasemy.

A legume 6 to 10 feet high, from British Guiana. A highly valuable forage plant for tropical and subtropical regions.

No. 224. Phaseolus trilobus. Starch Bean.

A kidney bean cultivated in India up to 7,000 feet. It would, therefore, probably do well in parts of the United States. It is an excellent forage plant. This bean has fleshy, starchy roots which are used for fattening cattle. They are also used in China in the manufacture of an arrowroot starch.

No. 225. Pisum arvense. Russian Blue Field Pea. (Fig. 29.)

There are many varieties of the field pea in cultivation, showing conclusively that it is one of the oldest forage plants, and yet it has not been brought to the attention of American farmers as largely as it deserves. In Canada the acreage is about the same as that of winter wheat. Much of the success of the Canadian farmers in fattening beef and pork for export is said to be due to their extensive use of pea hay and oat hay and pea meal.

The field pea is adapted to cultivation in the northern tier of States, from New England to Washington. It is sown in early spring at the proper time for seeding grain, using from 1 to 1½ bushels of peas and an equal quantity of either oats, wheat, or barley. The crop is ready to cut for hay when the dominant variety in the mixture is nearly ripe. If there are more peas than grain, then the yellowing of the pea vines and pods marks the proper time for cutting, or if the oats exceed the peas the mixture should be cut when the grains are in the dough stage. For a seed crop the peas are often grown alone.

The field pea is not suitable for cultivation in the Middle or Southern States, because of the ravages of a vine mildew which affects the yield of forage and seed. It requires a long, cool season, with gradually increasing heat toward the time of maturity. According to average analyses, 100 pounds of Minnesota-grown pea hay contained 12.4

pounds of crude protein and 66.2 pounds of fat and carbohydrates. Of this, 7.6 pounds of protein and 41.5 pounds of the carbohydrates were digestible, giving a nutritive ratio of 1 to 5.7. One hundred pounds of the seeds contained 90.2 pounds of dry matter, of which 80.2 pounds were digestible, having a nutritive ratio of about 1 to 3. The average of all American analyses shows a nutritive ratio for the seed of 1 to 2.8 and for pea meal of 1 to 3.2. This shows the peas to be a richer food than wheat bran,



FIG. 29.—The Russian blue field pea (*Pisum arvense*): a, flowering branch; b, pod.



FIG. 28.—The fleshy root of the Metcalfe bean.

but less concentrated than the gluten, linseed, cotton-seed, and soy-bean meals. The field pea is an excellent soiling crop for late spring and early summer use, furnishing a large amount of succulent forage which is relished by cattle. It deserves wider cultivation by Northern farmers.

No. 226. *Pisum sativum*. Garden Pea.

The garden pea, so generally cultivated as an early spring vegetable, is equally valuable as a fodder crop, but it requires richer land and is more quickly affected by drought than the field variety. Some botanists regard this as a cultural variety of the field pea.

No. 227. *Pithecolobium brevifolium*. Huajillo.

A spiny leguminous shrub, indigenous to the lower Rio Grande Valley. According to Dr. Havard, the persistent foliage is readily eaten by sheep and goats in the winter time.



FIG. 30.—Knotweed (*Polygonum aviculare*).

spring forage in barren pastures. Some of the prairie species grow on salt marshes and alkali spots.

No. 230. *Polygonum aviculare*. Knotweed. (Fig. 30.)

A weedy annual of the buckwheat family, common everywhere in dooryards, waste places, and fields. The stems are slender, prostrate or ascending, branching, 6 to 14 inches high, the leaves oblong to lanceolate, rather small, pointed at each end, and bluish green. It is very hardy, growing readily on the poorest of soils, even in times of drought, and is relished by all kinds of stock. Stockmen in the Northwest esteem it highly, as it furnishes a palatable and nutritious forage, which continues green all summer under all kinds of hard treatment. The dry forage contains nearly 19 per cent of crude protein, so that its value as a muscle maker is high, ranking above that of the clovers.

No. 228. *Plantago gnaphaloides*. Woolly Plantain.

A low annual with rosettes of silky narrow leaves. It is one of the earliest plants to start in spring, and supplies some little grazing at that time. Later it gets dry, and is not eaten. It is very common on the prairies west of the Mississippi River.

No. 229. *Plantago lanceolata*. Rib Grass.

A weed extensively naturalized in this country in lawns and meadows, and rightly considered a vile pest, but in Europe frequently recommended for sowing in pasture mixtures. The only advantage it has is that of growing on the most sterile soils. Cattle and sheep are fond of it when young. There are a number of American species, widely distributed in all parts of the country, many of which add value to the scanty

No. 231. *Polygonum emersum*. Tanweed.

This is well regarded as a forage plant for wet meadows and marshy places. It is abundant throughout the United States, and is one of the species which would not become a weed if brought under cultivation. Cattle are very fond of it. There are numerous other species of knotweed which in the localities where they grow add materially to the value of pasturage.

No. 232. *Polygonum erectum*. Upright Knotweed.

A hardy annual knotweed, widely distributed in the Northern States. In the upper prairie region it is highly valued as a forage plant for milch cows. It grows from 10 to 15 inches high, and in rich, moist soils may be cut for hay. The hay is nutritious, containing 11 per cent of crude protein.

No. 233. *Polygonum ramosissimum*. Bushy Knotweed.

A much-branched, erect annual weed 1½ to 3 feet high, with rather sparse leaves 1 to 2 inches long. It is a native of the semiarid plains and foothills from Texas to Idaho. Bushy knotweed is closely grazed by cattle and sheep and supplies quite an amount of nutritious forage in summer and early autumn. The seeds are abundantly produced and are considered fattening. It is a relative of the buckwheat.

No. 234. *Polygonum sachalinense*. Sachaline.

Giant knotweed or sachaline is a hardy herbaceous perennial, 6 to 12 feet high, with strong creeping rootstocks, broad, somewhat heart-shaped, shining leaves nearly a foot long, and small greenish-white flowers appearing late in the season. It has been cultivated for a good many years as an ornamental plant. Recently attempts have been made to introduce it into this country as a forage plant, and extravagant claims have been made concerning it. Considering that it is a native of northern Asia, growing along moist river banks upon an island with a cold and very moist climate, and from the recommendations as to its culture by horticulturists who have had experience in growing the plant, it is very doubtful if it will prove a success except in swampy waste lands. The leaves are eaten by cattle, but the small quantity of forage produced and the time which one must wait until production commences preclude its ever being of great value in this country.

No. 235. *Portulaca oleracea*. Purslane.

This well-known weed is of considerable value as an autumn forage plant in the South and Southwest. The fleshy leaves and stems are put forth in great abundance during the hottest and driest weather, and it is hard to kill. The same qualities which make it a vile pest in our gardens and cultivated fields cause it to be highly esteemed by sheep herders and cattlemen in years of drought. Fed to cows it increases the flow of milk, but acts as a laxative if too much is given at once.

No. 236. *Portulaca pilosa*. Cotton Purslane.

A low, fleshy-leaved annual with tufts of hairs at the bases of the leaves, giving it a cottony appearance. It appears early in spring on the Texas ranges, and is grazed by sheep.

No. 237. *Potentilla*. Cinquefoil.

There are a number of species native to the prairie regions west of the Missouri River. According to Bessey, they contribute some value to the native pastures. They belong to the Rose family and are closely related to the strawberry, which they resemble in foliage and habit of growth.

No. 238. *Poterium sanguisorba*. Burnett.

A so-called clover, belonging to the Rose family, the foliage of which resembles that of sainfoin. In the early part of the present century its cultivation was highly recommended, and extravagant claims were put forth concerning it, but it is now only used in mixtures for sheep pastures on dry and barren sandy or calcareous fields, such as are suited to the growth of sainfoin. The seeds of Burnett are sometimes used to adulterate the latter, to which it is inferior in value because of the smaller amount of forage which it produces. The hay contains about 15 per cent of crude protein.

No. 239. *Prosopis juliflora*. Mesquite Bean. (Fig. 31.)

There are two well-known varieties of the small tree that produces this bean. The pods or beans are not only eaten by all classes of stock, but the Mexicans and Indians use them as a food. The pods are straight or curved. In one variety the bark of the tree is much rougher than in the other, and the bean is bright yellow when ripe and much sweeter to the taste, the color of the other being reddish rather than yellow. The mesquite bean is a thorny, leguminous shrub, growing in favored localities to a tree from 20 to 40 feet high, with a trunk sometimes reaching 2½ feet in diameter, but usually not more than 10 or 15 feet high. It is widely distributed from Texas to southern California, through tropical America to Argentina. The leaves are very good browsing for horses and cattle. It bears two or more crops of beans a year, which are equal to barley for fattening horses, cattle, sheep, and hogs. The leaves, pods, and bark are rich in tannin, and a gum similar to gum arabic exudes copiously from the trunk and branches. The wood is hard, strong, and durable and takes a high polish. It is the most common tree of the mesas of the Southwest and because of its many uses is an exceedingly valuable species. Experiments in a small way

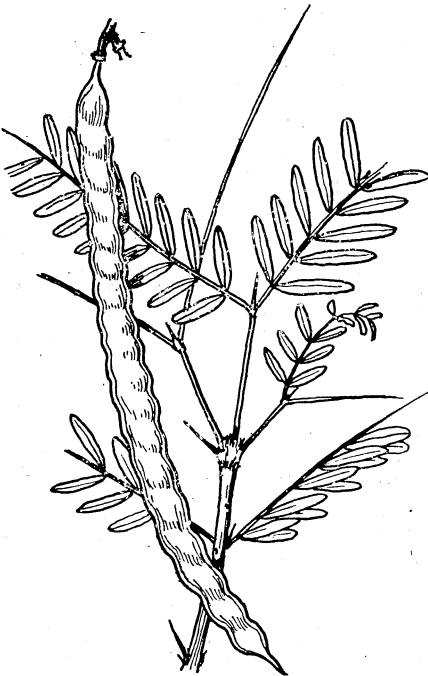


FIG. 31.—Mesquite Bean (*Prosopis juliflora*).

have been made to preserve the beans for winter feeding with partial success only, because of a small weevil that bores into them after they are gathered and renders them unfit for stock feed. One acre of land well covered with mesquite trees often produces not less than 100 bushels of the beans per annum. The mesquite bean is looked upon by some as a curse and by others as a blessing. The trees are spreading with great rapidity since prairie fires are no longer set to keep the growth of this and other weedy plants in bounds. Within the last twenty years both the mesquite bean and the prickly pear have covered many square miles of land in Texas which was formerly open prairie. There is no doubt that the amount of grazing has been diminished by the spread of mesquite brush. On the other hand, the beans are of decided value in times of drought,

when grass is scarce. It is probable that the mesquite bean is now of less value than formerly before it was known that alfalfa could be successfully grown for winter feed or the hay used in time of drought.

No. 240. *Prosopis pubescens*. Tornillo.

A shrub or small tree similar to the mesquite bean; abundant along the lower Rio Grande and its tributaries. The pods are eaten by cattle. They are also used as food by the Mexicans and Indians. It may be distinguished from *P. juliflora* by its thick, spirally-twisted pods, those of the former being straight or curved.

No. 241. *Psoralea esculenta*. Prairie Turnip.

A perennial legume common in the prairie region. It produces edible tubers. Formerly used as food by the Indians and voyageurs, and probably of some value as food for hogs. It might be tested in cultivation for the purpose of improving the sweetish tubers.

No. 242. *Psoralea glandulosa*. Jesuit's Tea.

A trifoliate, bushy, leguminous shrub, native of Chile, which there grows in gullies and water courses which are dry in summer. It is eaten by cattle and horses and is being introduced into California as a forage plant for arid pastures.

No. 243. *Psoralea melilotoides*. Shoe-string.

This and other species occur on dry pasture lands in the Southern States, and are said to be eaten by all kinds of stock. There are about a dozen species native to the prairie region, which add value to both pasturage and hay. Because of their tough, slender roots they are commonly known as "shoe-strings."

No. 244. *Quercus garryana*. Garry's Oak.

An oak growing on the slopes of Mount Hood in Oregon. Sheep are extremely fond of the acorns, which are commonly produced in great abundance. (Coville.)

No. 245. *Rhagodia*. Saltbush.

A dozen kinds of *Rhagodia* saltbushes grow in the alkaline semiarid desert of central Australia. All are eaten by stock. They are mostly spiny shrubs, much like the salt sages of the West. Von Mueller states that *R. billardieri* is one of the best plants for binding drifting sands along the coast, resisting the beating of salt spray driven by strong gales, and supplying also some forage.

No. 246. *Rhagodia hastata*. Arrow-leaf Saltbush.

An erect, perennial shrub, formerly very abundant in western Queensland and New South Wales, but which has now almost disappeared because of overgrazing by cattle. It grows 5 to 10 feet high, frequenting low, moist places. The whole plant is whitish, with a mealy covering like that on the leaves of the common garden goose foot or lamb's-quarters (*Chenopodium album*). Cattle and sheep browse the leaves and tender branches, seldom permitting it to ripen seed in any quantity, but it grows well from cuttings and may be rapidly disseminated in that manner.

No. 247. *Rhagodia parabolica*. Old-man Saltbush.

A low, spreading, perennial shrub, seldom growing more than 3 to 5 feet high. Its leaves and branches are whitish. Cattle and sheep graze this plant wherever found. It grows wild in Queensland, New South Wales, and Victoria, and is said to be one of the most drought resistant of all the saltbushes. It will stand some frost, and would be a good plant to introduce on the cattle ranges of Texas and New Mexico. Like all others of this group, it not only produces an abundance of seed, but may readily be reproduced from cuttings.

No. 248. *Richardsonia scabra*. Mexican Clover. (Fig. 32.)

An annual weed, native of Central America and Mexico, which has been introduced into the Southern States and has now spread along the Gulf westward into Texas. It is a succulent, creeping, prostrate plant, chiefly valued as a renovator of sandy fields on the coast. It is not a true clover, but belongs to the Rubiaceæ, the family in which coffee is included. Reports concerning it are conflicting. According to some it is a valuable pasture plant, while others affirm that neither cattle nor horses will eat it. On rich lands it can be cut, making a nutritious and palatable hay, which is readily eaten by all kinds of stock. Chemical analysis shows that the hay contains nearly as much nutriment as red clover. It is never cultivated, but appears as a weed after corn and

cotton have been laid by. In Florida it is considered an excellent plant to grow in orange groves as a mulch and to turn under for green manure, but not equal to either beggarweed or velvet bean.



FIG. 32.—Mexican Clover (*Richardsonia scabra*).

No. 249. *Rubia*. Madder.

The foliage of this prickly dye plant makes forage of fair quality if cut the second season, before the plants have commenced to blossom.

No. 250. *Salicornia herbacea*. Saleratus Weed.

A low, fleshy, leafless herbaceous plant, growing in the borders of salt marshes from Arizona to the Saskatchewan, and along the Atlantic coast. It occurs on soils too salty or too alkaline to support any other plant. In portions of the Southwest it is valued highly for winter feed. After frost stock live almost entirely upon saleratus weed, winter fat, sagebrush, green sage, and the native salt-

bushes, depending more on these than on the grasses.

No. 251. *Salix nuttallii*. Willow.

The characteristic willow of the "burns" in the heavy west-slope forests of the Cascade range in Oregon. The leaves and twigs are browsed by sheep.

No. 252. *Sarcobatus vermicularis*. Greasewood. (Fig. 33.)

The name greasewood is commonly applied to a number of thorny shrubs characteristic of strongly alkaline soils. The common greasewood, or Chico plant, of the Rocky Mountains ranges from the Upper Missouri and Platte rivers to the Gila and the eastern slope of the Sierra Nevadas. It grows to the height of 4 to 8 feet. The narrow leaves are usually 1 to 1½ inches long, and are very numerous on the young shoots and branches. Many of the latter are thorn-pointed. One would never imagine that this greasewood could have any value as forage, yet cattle and sheep eat the leaves and browse the smaller stems. The seeds are also eaten. An analysis of the ash of this plant at the New Mexico Experiment

Station showed 22 per cent of potash and 23.9 per cent of soda present. A sample of soil taken from under one of the plants contained two-tenths per cent of black alkali, while a similar sample taken 20 feet away from the plant showed no black alkali. Greasewood develops a thick taproot that goes down 15 or 20 feet or more, and it also sends out lateral surface roots through a radius of from 8 to 12 feet. Large amounts of the soda salts, especially the carbonate, are absorbed. Much of it finds its way into the leaves during the natural processes of growth. Then, as these fall during the winter, there is an accumulation or concentration of soda in the surface soil as a result of decomposition and the leaching out of the soluble substance of the leaves. Greasewood is tolerant of an amount of sal soda that would not only prevent germination of the seeds of cultivated plants, but would destroy the living plants themselves. It is an almost sure indicator of black alkali. Western ranchers recognize the general rule that lands covered with greasewood can not be profitably reclaimed.

No. 253. *Scirpus atrovirens*. Meadow Rush.

A sedge with rather stout triangular stems, $1\frac{1}{2}$ to 3 feet high, and broad, smooth bright-green leaves, which become rigid with age. Widely distributed through the upper prairie and lake regions in wet, boggy meadows. It is readily eaten by stock, but does not occur in sufficient quantities to be of much importance.

No. 254. *Scirpus fluviatilis*. River Club-rush.

A stout, erect perennial sedge, with sharply three-angled stems 3 to 5 feet high, and large, broad, flat leaves, which are smooth except on the roughened mid-ribs and margins. It is common on the borders of lakes and large streams from New England west to the Dakotas and Iowa, and, because of its abundance, is valuable for early feed. In wet meadows it often contributes a large percentage of the feed. The hay contains 10 per cent of crude protein.

No. 255. *Scirpus hallii*. Hall's Rush.

A slender tufted sedge, 6 inches to a foot high, growing on the borders of ponds from Texas to South Dakota. It is readily eaten by stock. The hay of this species contains 10 per cent of crude protein.

No. 256. *Scirpus maritimus*. Sea Club-rush.

A perennial sedge, with stout, erect, sharply three-angled stems 1 to 3 feet high, and long linear leaves. It is common in saline marshes on the coast from Nova Scotia to Florida, and in the interior across the continent. It furnishes a large amount of coarse forage, and is often converted into hay, because it can be cut early in the season before the grasses are in condition to mow. The hay contains nearly 10 per cent of crude protein.

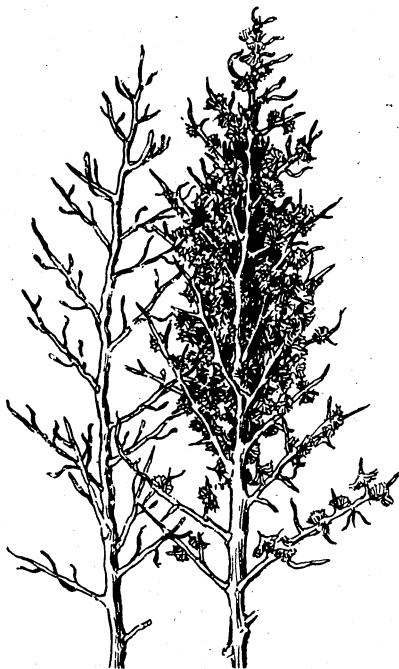


FIG. 33.—Greasewood (*Sarcobatus vermicularis*).

No. 257. *Senecio triangularis*. Bitter weed.

Abundant in meadows and along streams in Oregon. "Sheep are very fond of it." (Coville.)

No. 258. *Sesbania ægyptica*. Peabush.

A perennial legume from tropical Asia. According to Von Mueller, it grows well as far north as Afghanistan and as far south as New South Wales. Hence, it would undoubtedly succeed in the Gulf States and Florida. The leaves, pods, and seeds are very nutritious and are much relished by cattle.

No. 259. *Sida elliotii*. Elliott's Sida.

A low, shrubby or bushy mallow, native of the South, which grows $1\frac{1}{2}$ to 2 feet high on hard, clayey soils and rocky land. It is an excellent pasture plant which readily catches from seed, provided the surface soil is scratched with a rake when the seed is scattered. Cattle, sheep, and hogs are fond of it, but horses and mules do not relish it. This sida has been quite widely introduced in the grazing regions of California. It apparently thrives better without than with irrigation, and is therefore of much value on waste lands designed for permanent pastures. It is not a good soiling crop, and should not be cut for hay.

No. 260. *Sida spinosa*. Spiny Sida.

A weed of the Mallow family, common in the Southern States. It has been recommended as a good crop for renewing worn lands and makes very fair winter grazing for cattle. However, it can not be compared with crimson clover for the same purpose, being essentially a weed.

No. 261. *Sinapis alba*. White Mustard.

An annual soiling crop similar to rape, grown in France. Seed at the rate of 11 to 13 pounds per acre is sown in August after wheat or other small grain, and the crop is ready to cut from September to November. (Vilmorin.). White mustard has about the same feeding value as rape.

No. 262. *Solidago*. Golden Rod.

There are a great number of species distributed throughout the United States. In New York and other portions of the East where sheep are raised, golden rod is highly esteemed as a fattening, healthful, and nutritious forage, though cattle and horses will not touch it.

No. 263. *Spergula arvensis*. Sand Spurrey.

An annual, producing a low, tangled mass of succulent stems with numerous whorled linear leaves. It produces a crop in eight or ten weeks, and is valuable as a catch crop in short seasons, and for soiling sheep and milch cows. It has been especially recommended as a first crop on the pine barrens of Michigan, to turn under for green manure. The air-dried hay contains about 12 per cent of crude protein. Spurrey has recently been rather highly recommended for sowing on the ranges in southern California. It is quite drought resistant and ripens seed very freely, so that if once widely scattered it would probably maintain a foothold for a good many years. It may, in part, fill a like want on the Texas ranges, and deserves a trial to determine whether it will hold its own as well on the uncultivated sod lands as in fields. In the East spurrey is rather common as a weed in fields and gardens.

No. 264. *Spergula maxima*. Giant Spurrey. (Fig. 34.)

Similar to common spurrey, but making a ranker growth. It is also slightly richer in flesh-forming ingredients, and is the more valuable species of the two.

No. 265. *Symphytum asperrimum*. Prickly Comfrey.

A coarse, rank-growing perennial herb, with purple flowers in nodding one-sided clusters, and large, rough leaves. A native of the Caucasus, which has been widely introduced and recommended as a forage plant for rich soils. It has been claimed that an enormous quantity of forage may be cut from an acre, but after extended trials in this country it is considered of less value than the clovers, and is now rarely grown. It is propagated from the roots, which are set in rows 18 inches apart, and 16 inches in the rows. Its cultivation is not recommended, except when it is desired to procure an enormous bulk of forage from a small amount of very rich land. Prickly comfrey has proved a success only in New York, Michigan, and Florida, in the latter State having been recommended as a good forage plant for waste, swampy lands.

No. 266. *Taraxacum dens-leonis*. Dandelion.

A widely distributed weed, introduced from Europe in grain and grass seed. Its leaves furnish a scant, but palatable and nutritious, early forage for sheep, and the seed is therefore sometimes used in pasture mixtures.

No. 267. *Tetragonia expansa*. New Zealand Spinach.

An annual herb of the order Ficoideæ; native of the seacoasts of Chile, Japan, Australia, and New Zealand. Used as a vegetable, and also recommended as valuable in sheep pastures in arid regions and on alkaline or saline soils.

No. 268. *Thermopsis mollis*. Mountain Pea.

A perennial legume, with palmately trifoliate leaves, and yellow flowers, in terminal racemes. The stems are 2 to 3 feet high. A native of the mountains of southern Virginia and North Carolina. It is readily eaten by stock.

No. 269. *Thermopsis montana*. Montana Bush Pea.

A stout perennial herb with erect clustered stems 2 or 3 feet high, native of the Rocky Mountains. Opinions differ as to its value, some considering it one of the best forage plants on the ranges, others claim that it is not relished by cattle, and that it is perhaps poisonous. The hay is readily eaten by stock if cut before the stems become woody. Another species, *T. rhombifolia*, grows in the eastern Rocky Mountains from Colorado northward.

No. 270. *Tillandsia usneoides*. Spanish Moss.

An epiphyte belonging to the pineapple family, abundant in Florida and the Gulf States, where it is a characteristic feature of the woodlands, its long stems hanging in festoons from the tree trunks and branches. Cattle eat it greedily. In times of drought when there is a shortage of other feed it is stripped from the trees and fed. The ash contains 3.48 per cent phosphoric acid, 13.39 per cent potash, and 13.04 per cent lime, and is valued at about \$14 per ton as a fertilizer. Besides being of value for forage, the Spanish moss is useful for a variety of purposes, notably as a fiber substitute for hair in stuffing mattresses and furni-



FIG. 34.—Giant Spurrey (*Spergula maxima*).

ture. It has been recommended as an excellent filter for freeing cane and sorghum juice of its crude impurities.

No. 271. *Tribulus maximus*. Tribulus.

A loosely branched, hairy, prostrate herb, related to the creosote bush, occurring in dry soils in western Texas and the arid Southwest. It is eaten by sheep and cattle. It springs up all over the country when there is plenty of rain, and is highly valued by stockmen on that account.

No. 272. *Trifolium agrarium*. Golden Clover.

A perennial wild European clover widely naturalized on sandy fields and by roadsides in the Eastern States as far south as Virginia. It is of some value in sandy pastures.

No. 273. *Trifolium alexandrinum*. Egyptain Clover. (Fig. 35.)

Berseem Muscovi: The great fodder crop of Egypt. As a catch crop, considered in lower Egypt as unequaled by any other plant. Winter culture is necessary for its success, as the hot summers kill or seriously injure the plants. The variety *Muscovi* has been grown successfully in England, according to Mr. George P. Foaden, secretary of the Khedivial Agricultural Society. It would be advisable to sow this variety as follows: In regions which can be irrigated, sow broadcast at the rate of not less than 40 pounds per acre. In Egypt as high as 50 and 60 pounds per acre are sown upon the mud left after subsidence of the Nile, or upon soil previously thoroughly overflowed by means of the irrigation ditches. Seed should be sown immediately after the subsidence of the water directly on the mud. As the plants are very sensitive to cold the seed should not be sown until all danger of frost is over. In Egypt the seed is sown toward the end of October, and the first cutting can be made after 45 to 50 days, while if sown 20 days later when cooler weather has set in, 70 days are required for the crop to reach a stage fit for cutting. If planted here in October, it is often left in the soil until the following June and five cuttings taken. This Mus-



FIG. 35.—Egyptian Clover (*Trifolium alexandrinum*).

covi variety is suited only for well-irrigated land, as it requires much water. For seed, the last cutting is omitted in June and the plants allowed to go to seed. This variety is not sown with wheat or barley, and in this respect differs from the two following varieties, *Saida* and *Fache*. *Saida*: This variety is the dry-land sort, requiring comparatively little water but giving fewer cuttings than the *Muscovi* variety. It should be sown after irrigation as in case of the latter variety, but requires much less water subsequently. Any attempt to grow it as a summer crop in very warm regions will fail, for it is distinctly a cool-season crop in Egypt. The three varieties mentioned have perfectly distinct uses, which should not be disregarded in any attempted culture. The tendency of the *Saida* variety is to trail or creep along the ground. Large

quantities of seed, 40 to 50 pounds per acre, are considered profitable for sowing. *Fache*: This is a strong, upright growing variety of Berseem, which is especially adapted to precede cotton or sugar cane. It is cut only once. It requires less water than the Muscowi. It is sown on the overflowed land which is not irrigated. It is often sown with wheat or barley, the wheat or barley being sown first, the *Fache* being added broadcast. (D. G. Fairchild.)

No. 274. *Trifolium alpinum*. Alpine Clover.

A European alpine species highly recommended abroad as a forage plant for mountain meadows.

No. 275. *Trifolium amphanthum*. Southern Clover.

A low, slender stoloniferous clover, occurring in Louisiana and Texas upon the most sterile soils. It spreads rapidly and reseeds itself freely, producing a large amount of early pasturage. It begins to blossom about the middle of May. It is one of our most promising native clovers.

No. 276. *Trifolium arvense*. Rabbit-foot Clover.

A silky branching annual 5 to 10 inches high, with soft, grayish, oblong heads. Common in old fields and on barren lands in the Eastern and Southern United States. Of little value, as it ripens early and disappears.

No. 277. *Trifolium badium*. Brown Clover.

A clover, native of England and northern Europe, which has some slight value for pasturage.

No. 278. *Trifolium beckwithii*. Beckwith's Clover.

A native of the eastern Rocky Mountain and Upper Missouri prairie regions. It has ascending stems 4 to 9 inches high, from strong perennial creeping rootstocks. It is very persistent, and endures all kinds of hard usage. It is much relished by stock. The hay contains nearly 14 per cent of crude protein. Beckwith's clover is highly valued by stockmen in the northwest. Attempts at its cultivation have not proved successful.

No. 279. *Trifolium carolinianum*. Carolina Clover.

A small perennial, procumbent, tufted clover, widely disseminated in waste places from Pennsylvania to Florida and Texas. It furnishes a small amount of forage, especially in the southwest extension of its range.

No. 280. *Trifolium filiforme*. Suckling Clover.

Indigenous to northern Europe on sandy clay soils. A nutritious forage in sheep pastures, there often used in mixtures for wet sandy meadows.

No. 281. *Trifolium fragiferum*. Strawberry Clover.

A wild clover, native of England and northern and central Europe, which much resembles white clover in appearance and nutritive qualities. It occurs in wet meadows and is much relished by stock.

No. 282. *Trifolium furcatum*. Western Clover.

A rank-growing clover 2 to 3 feet high, native of the Pacific coast. The flower heads resemble those of common red clover, but are larger, sometimes 2 inches in diameter, and borne on long stalks. It is abundant throughout the coast ranges and affords good pasturage.

No. 283. *Trifolium hybridum*. Alsike Clover. (Fig. 36.)

A perennial, in size and general appearance intermediate between white and red clovers. It is better adapted than any other species in general cultivation to wet meadows or marshy lands, but because of its shallow root system will not withstand drought. The branching leafy stems grow 1 to 3 feet high, and

the young flower heads are at first white and later become rose-colored. Its leaves are slightly bitter, and on this account the forage is not so well liked by stock as that of red or white clover; but it will grow on lands which are too wet for the other species, thriving even in marshy places where the subsoil is impervious to water and the drainage is bad. It may also be cultivated in the far North and in high altitudes, as it has the power of withstanding severe cold. The forage is succulent and more difficult to cure for hay than red clover. The air-dried hay contains from 10 to 13 per cent of crude protein. It is a very good honey plant for bees. The seed weighs 65 pounds to the bushel, and 12 pounds will sow an acre. It is rarely sown alone, being used in mixtures with red-top or the bent grasses for wet meadows.

No. 284. *Trifolium incarnatum*. Crimson Clover. (Fig. 37.)

An annual, native of the Mediterranean region, which has been long cultivated in



FIG. 36.—Alsike (*Trifolium hybridum*).



FIG. 37.—Crimson Clover (*Trifolium incarnatum*).

the warmer portions of Europe, and is now grown in many of the Eastern and Southern States for an early soiling crop and green manure. The stems are erect, tufted, soft-hairy all over, from 1 to 2 feet high, and the bright scarlet flowers are borne in elongated heads. It should be sown in midsummer to furnish winter and early spring forage. It is not suited to the Northern and Northwestern States, as it freezes out in severe winters. Fifteen to 20 pounds of seed should be sown per acre. Hay made of crimson clover contains about 13 per cent of crude protein. To make the best hay, it must be cut when in full bloom; cut later, there is some danger in feeding it, especially to horses, on account of the bristly, hairy bracts of the inflorescence, which form hair balls in the stomach. A number of such cases, resulting in considerable loss, have been reported during the past seasons. Crimson clover is one of the best soil-

cover crops to use in orchards, supplying nitrogenous fertilizer in an economical form. It is a good crop to sow after grain harvest, and finds a variety of uses in any system of intensive farming. White crimson clover, a white-flowered form of the above, is less hardy and from two to four weeks later than the crimson flowered one. It has been tried extensively in the South with fair results.

No. 285. *Trifolium involucreatum*. Purple Clover.

An annual, 1 or 2 feet high, with leafy, branching stems, terminating in from one to three purplish heads. It has a wide range throughout the West. Cattle and sheep are very fond of it.

No. 286. *Trifolium longipes*. Long-stalked Clover.

A native clover rather common in the meadows and parks of the northern Rocky Mountains. Sheep and cattle are very fond of it.

No. 287. *Trifolium megacephalum*. Mountain Red Clover. (Fig. 38.)

This wild clover grows in the mountains from Montana to California. It is distinguished from red clover in having unbranched stems about a foot high, and wedge-shaped five- to seven-parted leaves which nearly all rise from the base of the stalks. The terminal flower head is about 1½ inches long. It is one of the best native pasture plants of the West.

No. 288. *Trifolium medium*. Mammoth Clover.

A rank-growing perennial with zigzag stems, oblong, entire, spotless leaflets, and stalked heads of purple flowers. It is better adapted to wet meadows or marshy lands than is the ordinary clover, and in such places makes a very rank and rapid growth. It has about the same feeding value as red clover, and is well adapted to soiling purposes. Ten pounds of seed should be sown per acre. Much seed of the common red clover is sold for this. The plants may be distinguished by the long-stalked flower heads.

No. 289. *Trifolium microcephalum*. Low-land Clover.

A wild species, well liked by stock, common on lowlands in southern California.

No. 290. *Trifolium minus*. Yellow Clover.

A European annual, extensively naturalized in the Eastern and Southern States in sandy fields and along roadsides. It is similar to Japan clover, for which it is often mistaken. It affords a small amount of forage in early summer, but its chief value is that it spreads rapidly over the most barren soils, thereby preventing the washing of the surface.

No. 291. *Trifolium ochroleucum*. Sulphur Clover.

A perennial European species 10 to 15 inches high, with elongated heads of pale yellow flowers. It grows wild upon the driest calcareous soils, and when cut makes a palatable and nutritious hay, greedily eaten by cattle.

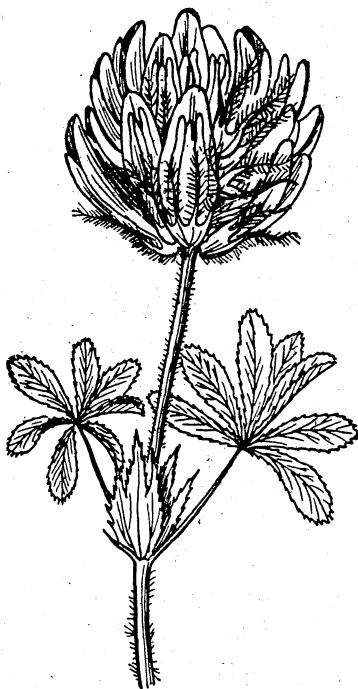


FIG. 38.—Mountain Red Clover (*Trifolium megacephalum*).

No. 292. *Trifolium pannonicum*. Hungarian Clover.

A perennial species indigenous to southern Europe, closely allied to red clover, and much earlier, but less readily eaten by stock.

No. 293. *Trifolium pratense*. Red Clover. (Fig. 39.)

A biennial or short-lived perennial clover, native of the Old World, but now extensively cultivated in all temperate climates. It is ascending, more or less branching, 1 to 2 feet high, with trifoliate leaves on long leaf-stalks and oval or blunt leaflets half an inch to an inch and a half long, with a large pale spot on the upper side, and pink flowers in large, rounded, stemless heads. Red clover holds the same position as a forage plant in the Eastern and Northern States as alfalfa in the Southwest and West, or as cowpeas in the South. Its cultivation

is almost universal. The seed is sown at the rate of from 15 to 20 pounds per acre, from March to May, either alone, or more commonly with grain. It requires a deep, rich, fertile, calcareous loam, neither too wet nor too dry. On the black-waxy and gumbo soils of the Mississippi Valley, red clover is almost sure to freeze out or "heave" in winter, and on rocky or light, sandy soil it suffers from drought in summer. It is mown for hay twice in the season, the yield varying from three-fourths of a ton to 2 tons at each cutting. The hay contains 12 per cent of crude protein, varying according to the fertility of the soil. The yield of seed ranges from 3 to 9 bushels, of 60 pounds each, per acre. It is one of the best money crops of the Eastern farmer, and is an excellent one for pasturage, soiling, and also to turn under for green manure. Red clover makes fine silage, alone or placed in alternate layers with corn. Pea-vine clover (*T. pratense* var. *perenne*), is a variety of red clover with more hairy leaves, weaker stems and larger blossoms. It is sometimes considered better than red clover for wet soils, or in grass mixtures.



FIG. 39.—Red Clover (*Trifolium pratense*).

No. 294. *Trifolium procumbens*. Hop Clover.

A low, annual, yellow-flowered clover, with spreading or ascending stems, widely naturalized in the Eastern and Southern States. It is common on sandy fields and roadsides, and furnishes scanty pasturage in early summer. It resembles Japan clover, and in the South is often mistaken for it.

No. 295. *Trifolium reflexum*. Buffalo Clover. (Fig. 40.)

A native annual or biennial species with ascending downy stems, oblong, finely toothed leaflets, and rose-red flowers on short stalks in a round, stalked cluster. The flowers are reflexed and brownish in fruit. Widely disseminated from western New York to Nebraska, Kansas, and southward, and especially abundant in the middle prairie region, where it furnishes a considerable amount of palatable and highly nutritious forage, greedily eaten by all kinds of stock. It is a species which should be brought into cultivation. It has been suggested that Buffalo clover might take the place of crimson clover as a winter

soil mulch and early spring soiling or green manure crop in the Southern States, where the latter does not succeed. It grows luxuriantly during the winter months and is quite common in southern Georgia and Alabama.

No. 296. *Trifolium repens*. White Clover. (Fig. 41.)

A smooth perennial, growing wild in New England and Europe and now widely cultivated for lawns and pastures. The slender spreading and creeping stems are from 4 to 8 or 10 inches long; the trifoliate leaves are on rather long leaf-stalks; the flowers are white or rose color, borne in loose heads an inch or less in diameter, on long stalks. It grows on a great variety of soils, forming excellent turf either for pastures or lawns, and thrives under all sorts of hard usage. If sown alone from 6 to 8 pounds of seed should be used, but it is usually mixed with the seed of grasses or other clovers. The forage, though produced in small quantity, is sweet and nutritious and eagerly sought for by all kinds of



FIG. 40.—Buffalo Clover (*Trifolium reflexum*).

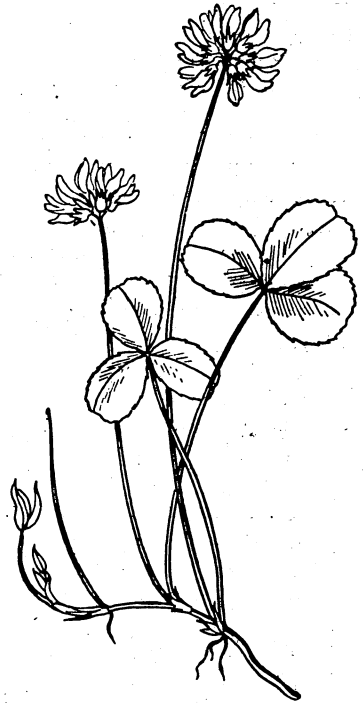


FIG. 41.—White Clover (*Trifolium repens*).

stock. Giant white clover, an improved Italian variety with broad leaves, has been grown experimentally at the North Carolina Experiment Station. The plants were very thrifty, but bore few flowers and ripened no seed.

No. 297. *Trifolium resupinatum*. Reversed Clover.

An annual species, native of the Mediterranean region, similar to white clover in its manner of growth, and better adapted to warm regions. It has been introduced into and is widely grown in northern India as a pasture plant, and may be a valuable species to introduce for pasturage in the Southern States.

No. 298. *Trifolium rubens*. Reddish Clover.

A perennial clover, native of southern Europe, similar in appearance to crimson clover, but with purple flowers and much narrower and longer leaflets. It is

cultivated for soiling purposes in the warmer portions of Europe, and, though less hardy than the crimson clover, would be a good species for introduction into the Southern States.

No. 299. *Trifolium stoloniferum*. Running Buffalo Clover.

A low, smooth perennial, which sends out long runners from the bases of the stems. The flowers are white, tinged with purple, in loose heads. The leaflets are broadly obovate and minutely toothed. A native species, growing in open woodlands and prairies from Ohio west to Kansas. Stock are quite fond of it.

No. 300. *Trifolium subrotundum*. Mayad Clover.

A perennial species, native to and cultivated in northern and middle Africa up to 9,000 feet elevation. It is a good species for countries too warm to grow red clover, and may do well in the Southern States.

No. 301. *Trifolium tridentatum*. Nevada Clover.

A wild clover, occurring in Nevada and Utah, which supplies palatable and nutritious forage in early summer, and is greedily eaten by cattle. It deserves to be brought under cultivation. The Western and Pacific coast States are very rich in the number of wild clovers which occur there. California alone has more than sixty species. All are valuable forage plants, but few, if any, have been given a trial in cultivation.

No. 302. *Triglochin maritimum*. Seaside Arrow-grass.

A marsh plant with cylindrical leaves and flowering stalks 1 to 3 feet high, common along the Atlantic coast and westward across the continent in saline, marshy, and boggy places. It is eaten by cattle, and adds some little value to the native herbage of wet pastures.

No. 303. *Trigonella fœnum-græcum*. Fenugreek.

An erect annual legume growing 6 to 12 inches high. The plant has a strong odor, and is valueless for forage unless it is cut before it commences to bloom. The seeds are used in most "condition powders" on account of their strong odor, but it is doubtful whether they have much medicinal value. It is extensively cultivated in Algeria, and is highly esteemed for fattening cattle.

No. 304. *Ulex europæus*. Gorse.

A perennial leguminous shrub, native of northern Europe. It is a forage plant for dry and barren hillsides, in places too steep or where the soil is too thin to admit of the cultivation of better ones. In some parts of Ireland and Wales the farm horses are almost entirely maintained upon it during the winter months, the crushed 2-year-old branches being fed at the rate of about 40 pounds per day. Twenty or 25 pounds of seed are required for an acre. It is a valuable forage plant to sow on barren hillsides. Sheep are very fond of and fatten quickly upon it. This legume is a strong potash feeder. Its roots penetrate deeply, bringing up stores of potash from the subsoil. On this account gorse is sometimes recommended as an excellent fertilizing crop to use in renovating hard and sterile soils.

No. 305. *Urtica dioica*. Stinging Nettle.

A perennial of long duration. Cultivated in France as an early soiling crop for mules and milch cows. The seeds are fed to horses. It grows in arid, sandy, and stony land and in very cold places where few other crops succeed. The seed germinate slowly. (Vilmorin.) This does not compare with rape, peas, or clover, and hardly deserves cultivation in this country.

No. 306. *Valeriana sitchensis*. Valerian.

"A common plant of moist open slopes and burns in the west slope forests of Oregon, closely eaten by sheep." (Coville.)

No. 307. *Vancouveria hexandra*. Vancouveria.

"A herbaceous plant of the heavy west slope forests of Oregon, very much liked by sheep." (Coville.)

No. 308. *Veratrum viride*. False Hellebore.

Rather common in the meadows in the Cascade range of Oregon. Sheep are very fond of the young leaves and shoots when they first appear.

No. 309. *Veronica peregrina*. Winter Purslane.

This insignificant annual appears in such abundance on the ranges just after the



Fig. 42.—American Vetch (*Vicia americana*).

melting of the winter snows that it becomes quite important as a forage plant. Sheep are very fond of it.

No. 310. *Vicia americana*. American Vetch. (Fig. 42.)

A smooth perennial with compound leaves, elliptical or oblong obtuse leaflets, and four to eight flowers on elongated flower stalks. It grows in moist soil from New York westward to the prairie region. A valuable native vetch, which should be given a trial in cultivation. Stock are very fond of it and fatten in pastures where it is abundant.

No. 311. *Vicia biennis*. Biennial Vetch.

A large, weak-stemmed biennial or perennial forage plant grown in France. It should be sown in mixtures with grain. Perhaps of value for the South.

No. 312. *Vicia cracca*. Bird Vetch.

A downy-pubescent perennial with compound leaves of 20 to 24 narrowly oblong, abruptly pointed leaflets and numerous blue or purple reflexed flowers in a one-sided spike. Common in the borders of thickets from New England to the upper prairie region. The species is cultivated in Europe for fodder and is recommended for cultivation in wet meadows. In the shade it yields a return three times larger than in open places. It would therefore be valuable in woodland pastures and alpine regions. In New England bird vetch is considered a bad weed in grain fields.

No. 313. *Vicia ervilia*. Black Bitter Vetch.

An annual legume adapted to hot, dry countries. Cultivated in Algiers and Tunis. It produces large crops of forage, but care must be used in feeding because both the seeds and the green fodder are considered heating. Estimates of the seed required per acre vary from 35 to 100 pounds. (W. T. Swingle.)

No. 314. *Vicia fulgens*. Scarlet Vetch.

An annual vetch from Algeria, with scarlet flowers. A very rapid grower, cultivated both as an ornamental plant and for forage. Dr. Trabut, of Algeria, considers this one of the most promising forage plants of that country. Seed has recently been imported by the Section of Seed and Plant Introduction, U. S. Department of Agriculture.

No. 315. *Vicia gigantea*. Giant Vetch. (Fig. 43.)

A tall perennial growing in the forest region of Oregon and Washington, highly valued there as a forage plant. It deserves to be brought into cultivation.

No. 316. *Vicia hirsuta*. Wild Vetch.

A wild vetch from South Carolina. "Cattle eat it with relish. It grows thick, starts early in spring, and promises to be a valuable forage plant." (R. T. Morrison.)

No. 317. *Vicia leavenworthii*. Stolley Vetch.

An early pasture plant from central Texas, which grows wild on the granite soils and red prairies. This vetch has the same habit and much the appearance of the hairy vetch. It branches from the base, the weak, trailing vines being 2 to 3½ feet long. As many as fifty or sixty stems and branches have been observed from a single root. It has a somewhat local distribution, occurring in central and western Texas. It grows in the creek bottoms and among the underbrush along streams, and where protected from destruction by cattle spreads to the open prairies. Seeds of this vetch were collected in 1897 and distributed for trial, but without favorable results.

No. 318. *Vicia ludoviciana*. Louisiana Vetch.

A wild vetch occurring in the South, where it makes a fair amount of nutritious grazing. It is reported to have been successfully cultivated, showing marked improvement in the amount of foliage and size of the plants when grown on well-tilled soil. A promising native vetch.

No. 319. *Vicia macrocarpa*. Big-seeded Vetch.

An annual like spring vetch, but with larger seeds, pods, and leaves. Grown in Algeria for forage and as a garden vegetable.

No. 320. *Vicia micrantha*. Small-flowered Vetch.

A smooth vetch with four to six linear obtuse leaflets, common in the South. It is eaten by cattle and should be grown under improved conditions.

No. 321. *Vicia monantha*. One-flowered Vetch.

An annual vetch, cultivated in France. Supplies forage of good quality on poor, sandy, or granitic soils. The seeds are eaten like lentils. Promising as a winter crop for the South. About 5 pecks of seed are sown per acre.

No. 322. *Vicia narbonensis*. Narbonne Vetch.

An annual, cultivated in southern France as a winter or early spring soiling crop.

No. 323. *Vicia peregrina*. Southern Vetch.

An annual, native of southern Europe and there cultivated, considered better than



FIG. 43.—Giant Vetch (*Vicia gigantea*).

the ordinary vetch for sandy soils. It might be valuable for like soils in the South.

No. 324. *Vicia sativa*. Spring Vetch. (Fig. 44.)

This is a leafy, annual, trailing herb, 1 to 2 feet high, with four-angled to five-angled stems, simple or branched from the base. The leaves are compound and are terminated with three or four tendrils. The five to seven pairs of leaflets are broadest above the middle, blunt or notched at the end, and tipped with an abrupt point (fig. 44). The flowers are rather large, deep purple, one or two together in the axil of the leaf on a very short stalk. The plant is soft and

hairy all over. This Old-World forage plant has been cultivated in Europe for upward of twenty centuries. It is a native of western Asia and of all Europe except Lapland. It was cultivated by the Romans, and was esteemed by them a valuable fodder crop. In Italy it has been grown continuously up to the present day. It is one of the many soiling crops in use in northern Europe and the British Isles. Spring vetch was first introduced into the United States in 1806 by the N. Y. Agricultural Society. It has been tried in nearly all the States and has proved very unsatisfactory, except for certain districts in New England, New York, northern Michigan, Wisconsin, and lower Canada. It was very largely grown throughout the New England and Northern States during the period from 1865 to 1885, but its cultivation there has now almost ceased, it having been found that the yield of hay or of green fodder is not a profitable



FIG. 44.—Spring vetch or tares (*Vicia sativa*):
a, pod.

one compared with that of the red and crimson clover and field peas. The principal drawback to more extensive cultivation is the high price of the seed (\$2.50 to \$3 per bushel of 70 pounds) and the fact that the plants can not withstand even temporary drought or hot weather. In England, where this crop is extensively used, the growing season is much cooler, with more rain and an equable temperature. Spring vetch seems to be adapted more particularly to northern countries, where the season is short and the rainfall abundant. The seed should be sown at the rate of 5 to 8 pecks per acre, with 1 bushel of rye or oats as a nurse crop. As high a seeding as 3 to 3½ bushels per acre is sometimes recommended, but the product per acre will not warrant the use of so much seed at the present high prices. Seed should be sown in April or May. The crop will be ready to cut by the middle of June or the first of July, from full bloom until the pods are half formed. The spring vetch is a trailing vine, which alone would lodge and make a dense mat. The object of the nurse crop is to furnish a support to lift the vines up off the ground and prevent loss of

foliage through rotting of the lower leaves. The vines are very difficult to harvest when sown alone, on account of the tangled mass of stems, but may be easily cut with a pea harvester. An acre of vetch and oats yields ordinarily from 6 to 8 tons of green forage. Where it can be grown, its chief value arises from the fact that it is ready to cut between the first and second crops of red clover, thus filling a gap in the series of early summer soiling crops. Spring vetches are also used for hay. To make hay, more care is required than with red clover. Two crops are sometimes cut in one season, and where this is possible the second is the one to be saved for seed. The first crop ripens very irregularly, and some of the pods will be shelled before the rest are ripe. Where this crop can be grown it makes a very good summer feed for horses, but must not be fed earlier than full bloom, on account of its diuretic action. It is good for soiling sheep and milch cows, and are said to very materially

increase the flow of milk. The percentage of digestibility of spring vetch forage has not been determined in this country, but analyses show a high food content, comparable with alfalfa rather than the clovers. The average sample of vetch hay contains 11.3 per cent water, 7.9 per cent ash, 17 per cent crude protein, 25.4 per cent fiber, 36.1 per cent nitrogen-free extract, and 2.3 per cent fat. The flat pea and the soy bean are the only leguminous fodders which exceed this in the crude protein content. At the time when ready to cut for hay the vetch contains about 20 per cent of dry matter, and in this 20 per cent there are contained 3.16 per cent nitrogen, 0.72 per cent phosphoric acid, and 3.36 per cent potash. Calculating on this basis the fertilizing ingredients contained in a crop of 12 tons of green forage produced from 1 acre, there would be 153 pounds of nitrogen, 37 pounds of phosphoric acid, and 163 pounds of potash. In addition to this the stubble and roots to the depth of 22 inches contain 27.2 pounds of nitrogen, 7.2 pounds of phosphoric acid, and 21.8 pounds of potash, making a total of 180.2 pounds of nitrogen produced in a single season by one crop of spring vetch, or as much as is contained in 18 tons of barnyard manure. Spring vetch is not recommended as a forage crop for general cultivation. It has value for some few northern localities, but has proved a signal failure elsewhere in this country. The plants come into flower very unevenly, so that sometimes the seed does not ripen in sufficient quantities at one time to pay for harvesting.

No. 325. *Vicia sepium*. Hedge Vetch.

A perennial vetch cultivated to some extent in France. Adapted to woodland pastures.

No. 326. *Vicia sitchensis*. Alaska Vetch.

A native of the Pacific coast from California to Alaska; valuable for forage; and deserves cultivation.

No. 327. *Vicia sylvatica*. Wood Vetch.

A perennial indigenous to Europe and northern Asia. It has been grown successfully as far north as 67° north latitude, and is available for alpine or subalpine pastures. The yield of forage is large and it is readily eaten by all kinds of stock.

No. 328. *Vicia tetrasperma*. Lentil Vetch.

An Old World annual which, according to Langethal, is preferable to the spring vetch for sandy soil. It is said to make better and more palatable forage and might be suited for cultivation in the Southern States, especially upon light, calcareous soils.

No. 329. *Vicia villosa*. Hairy Vetch. (Plate II, fig. 2; and fig. 45.)

This annual leguminous plant is a native of western Asia. It has been cultivated for about fifty years in some parts of Europe, especially southern Russia, Germany, and France, and was introduced into this country for the first time about 1847, under the name of Siberian vetch. Its cultivation was then neglected until its reintroduction about twelve years ago by this Department. It has since been tried in various parts of the United States. Excellent reports as to its drought-resisting qualities and its adaptability to our climate have been received from Washington, Nebraska, Georgia, New Mexico, South Dakota, Minnesota, Montana, and Pennsylvania. It has been grown on the experimental grounds of the Department of Agriculture at Washington, D. C., and has proved to be thoroughly adapted. Hairy vetch withstands winter cold and summer drought, but it does not do well where there is an excess of water in the soil. It is one of the most promising fodder crops which has been brought into the

United States in recent years, and by some is considered especially valuable for light sandy soils. Hairy vetch may be sown in autumn, from about the middle of August to the middle of September; or in spring, from the latter part of April to the middle of May. It should be sown broadcast or with a grain drill at the rate of 1 to 1½ bushels of seed per acre. The latter method will require a less amount of seed. When the seed is put in broadcast, a bushel of rye, oats, or wheat should be sown at the same time, so as to furnish a support



FIG. 45.—Hairy vetch (*Vicia villosa*): a, section of stem; b, flower; c, stamens; d, pod.

to keep the vines up off the ground. If it is sown in drills in the latter part of August the crop should be cultivated several times. It will furnish some forage in autumn, and where the winter is not too severe will start to grow again in the spring, thus producing forage in late autumn and early spring, at the two periods when it is most needed. While it gives a fair crop on poor soil it is most profitable as a forage plant on rich and well-tilled land. It needs considerable moisture during the first six weeks of its growth, but when once fairly estab-

lished withstands drought and extremes of temperature. The seeds germinate poorly when they are more than two years old. Most of the seed used in this country is imported from Europe, so that particular care ought to be taken by importers and dealers to handle none but such as can be sold under guarantee as good, fresh seed. At the Mississippi Agricultural Experiment Station seed of this vetch was sown in October, 1888, and since that time has given heavy annual crops on the same ground, although receiving no attention. Its seeds germinate with the first autumn rains, and cover the ground by the first of January, furnishing good grazing until April or May. If the stock is taken off the field in March the plants will mature and reseed the ground freely for the next year. Hairy vetch is eaten with relish by all kinds of stock. If properly cured it makes good hay, though on account of its habit of growth the process is difficult. It has been tested in the silo in alternate layers with green corn and also alone. The former method is the one to be used if the best ensilage is desired. It is a most excellent forage plant for soiling purposes. On account of the difficulty of cutting it properly, it will give the most satisfactory results fed in this way.

No. 330. *Vigna catjang*. Cowpea. (Fig. 46.)

Cowpeas have been in cultivation in this country for about one hundred and fifty years, having been originally introduced into South Carolina. They have spread from that source and from other importations of seed direct from China and India, until now they are in general use throughout the region south of the Ohio River and on the Pacific coast, and as a soiling crop in the New England and Northern States. There are over one hundred named varieties of cowpeas grown in this country. These are distinguished from one another chiefly by the color and shape of the seed, the arrangement of peas in the pod, and the general habit of growth of the plant. Thus, there are the bush peas, which grow in an upright form, having short lateral branches from a single central stem; there are trailing varieties with prostrate runners 15 or 20 feet long, and there is every possible gradation between these extremes. The peas are of every shade of white, yellow, green, pink, gray, brown, red, and purple to black, of uniform color or variously mottled, spotted, and speckled. There is also variation in the length of the season of the different varieties, from six weeks to as many months. The usual method of cultivation of cowpeas is to sow them alone broadcast or in drills, or between the corn rows at the last cultivation, the rate of seeding varying from 8 to 24 quarts per acre. Care must be taken not to plant the seed before the ground has become warm, as, like other beans, the cowpeas do not germinate well if the soil is wet and cold. This crop is even more susceptible to unfavorable conditions than Indian corn, but in mid-summer the vegetation becomes most luxuriant. Cowpeas are the best soil renovators for the Southern States, and will grow on land too poor to support any of the clovers, producing a large amount of herbage which may be plowed under as green manure. Cowpea vines are, because of their luxuriant growth and long, trailing stems, difficult to make into good hay; but by proper care, curing them in racks or over poles, so that the air may enter into every portion of the pile, an excellent quality of hay is produced, and if the bunch varieties are sown rather late in the season they may be mowed without difficulty. Cowpea hay containing 89.3 per cent total dry matter averages higher (10.79 per cent) in crude protein than clover hay. It is even more difficult to make good cowpea hay than good alfalfa hay, so that the content of crude protein often falls below that figure. One thousand pounds of cowpea hay contain, according to an average of all available American analyses, 19.5 pounds nitrogen, 5.2 pounds phosphoric acid, and 14.7 pounds potash. The nutritive ratio of cowpeas is 1 to 3.9. The crop is usually cut for hay when the first pods are ripe and the

stems are commencing to turn yellow. When growing cowpeas for fertilizer, it is best either to feed the vines and return the manure to the soil or to plow them under at once, instead of letting them stay on the ground all the winter. By the

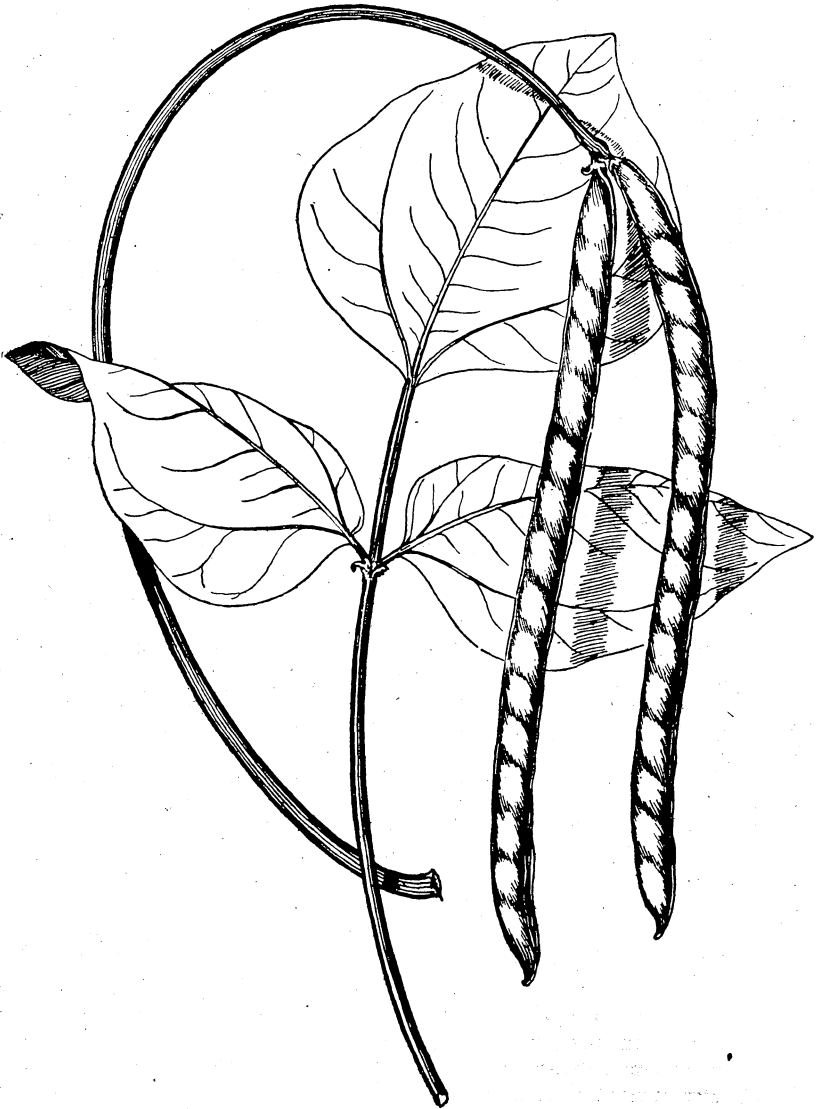


FIG. 46.—Leaf and pods of the cowpea (*Vigna catjang*).

latter practice there is often a loss of two-thirds of the fertilizing value of the vines because of the leaching out of soluble fertilizers by the winter rains. The feeding value is far greater than the fertilizing value, so that it is better to use them either green or as hay than to turn the crop under.

No. 331. *Xanthisma texana*. Xanthisma.

A virgately branching perennial weed 1 to 3 feet high. Grows in Texas in fields and waste places and in stony pastures. The yellow flowers and seed heads are cropped off by cows and mules. They do not touch other parts of the plant. The flow of milk is said to increase during the time when this weed is in flower because of the cows eating the nutritious oily seeds.

No. 332. *Xerophyllum tenax*. Bear grass.

A native of the Cascade Mountains of Oregon. "Sheep eat the young leaves and the seed pods." (Coville.)

No. 333. *Yucca baccata*. Spanish bayonet.

A perennial of the lily family, with stout, woody trunk several feet high, crowned at the top with a rosette of long sword shaped leaves. Of no value as a forage plant except in seasons of drought, when the cattle and sheep on the ranges in Texas and Arizona eat the leaves, perhaps as much for the water which they contain as for food.



INDEX.

[The English names printed in *italics* are the ones in most common use; these only appear in the text. The references are to the numbers, not to pages.]

	No.		No.
<i>Abronia</i>	1	<i>Bear grass</i>	331, 332, 333
<i>African Tansy</i>	215	<i>Beckwith's clover</i>	278
<i>Alaska Vetch</i>	3-6	<i>Bed-straw</i>	116
<i>Alexandrian clover</i>	273	<i>Beggar weed</i>	91
<i>Alfalfa</i>	198	<i>Canada</i>	87
<i>clover</i>	198	<i>Few-flowered</i>	90
<i>Alfilaria</i>	103, 104	<i>Florida</i>	91
<i>Alfilarilla</i>	103, 104	<i>Leafy</i>	86
<i>Alpine clover</i>	274	<i>Naked-flowered</i>	88
<i>Alsace clover</i>	283	<i>Texas</i>	89
<i>Alsike clover</i>	283	<i>Three-flowered</i>	92
<i>American graybush</i>	138	<i>Belli-mountain</i>	248
<i>American sweetweed</i>	123	<i>Bersine clover</i>	273
<i>Annual saltbush</i>	28	<i>Biennial vetch</i>	311
<i>Annual snail clover</i>	200	<i>Big-headed rush</i>	135
<i>Apache plume</i>	109	<i>rooted vetch</i>	146
<i>Arabian snail clover</i>	195	<i>seeded vetch</i>	319
<i>Arrow grass</i>	302	<i>weed</i>	8
<i>Arrow-leaf saltbush</i>	246	<i>Bird vetch</i>	312
<i>Artichoke</i>	128	<i>Bird's-foot clover</i>	175
<i>Asparset</i>	211	<i>trefoil</i>	175
<i>Australian graybush</i>	139	<i>Bitter cassava</i>	190
<i>Australian saltbush</i>	34	<i>vetch</i>	155
<i>Balsam-root</i>	38	<i>weed</i>	257
<i>Bastard clover</i>	283	<i>Black-bitter vetch</i>	313
<i>Beach-pea</i>	147	<i>grass</i>	134
<i>Bean</i>	218	<i>medick</i>	194, 195
<i>Broad</i>	107	<i>Bladder clover</i>	281
<i>Carob</i>	59	<i>saltbush</i>	36
<i>Cocko</i>	91	<i>Blue lupine</i>	182, 185
<i>Common field</i>	107	<i>saltbush</i>	64
<i>Creeping kidney</i>	217	<i>weed</i>	130
<i>Everlasting</i>	221	<i>Boerhavia</i>	41
<i>Horse</i>	107	<i>Bokhara clover</i>	202
<i>Indian</i>	220	<i>Bourgoyne</i>	211
<i>Mesquite</i>	239	<i>Brazilian clover</i>	198
<i>Metcalfe</i>	222	<i>Broad bean</i>	107
<i>Miller</i>	112	<i>Brown clover</i>	277, 294
<i>Screw</i>	240	<i>Buckhorn clover</i>	303
<i>Soy</i>	119	<i>Buckwheat</i>	108
<i>Straight</i>	107	<i>Bud-brush</i>	22
<i>Velvet</i>	210	<i>sage</i>	22
<i>Wild kidney</i>	221	<i>Buffalo clover</i>	295
<i>Yam</i>	214	<i>pea</i>	187

	No.
<i>Bur clover</i>	192, 195, 214, 217
<i>Burnett</i>	238
<i>clover</i>	238
<i>Bush clover</i>	168
<i>lespedeza</i>	165
<i>pea</i>	269
<i>Bushy Dalea</i>	83
<i>knotweed</i>	233
<i>Butterfly pea</i>	69
<i>Butterweed</i>	101
<i>Cabbage</i>	43
<i>Cabule clover</i>	202
<i>California bur clover</i>	192
<i>Californian greaseweed</i>	6
<i>Camote del monte</i>	216
<i>del Raton</i>	130
<i>Canada beggarweed</i>	87
<i>Canada field pea</i>	225
<i>Careless weed</i>	9
<i>Carnation clover</i>	284
<i>Carob bean</i>	59
<i>tree</i>	59
<i>Carolina clover</i>	279
<i>Cassava</i>	189
<i>bitter</i>	190
<i>Cat clover</i>	276
<i>in-clover</i>	176
<i>Catspaw</i>	143
<i>Chamaerhodes</i>	62
<i>Chestnut brown clover</i>	299
<i>sedge</i>	76
<i>Chick pea</i>	65
<i>Chicken vetch</i>	312
<i>Chicory</i>	67
<i>Chilean clover</i>	198
<i>China grass plant</i>	40
<i>Chinese yam</i>	93
<i>Chufa</i>	77
<i>Cinquefoil</i>	237
<i>Cloth plant</i>	40
<i>Clover, Alexandrian</i>	273
<i>Alfalfa</i>	198
<i>Alpine</i>	274
<i>Alsike</i>	283
<i>Annual snail</i>	200
<i>Arabian snail</i>	195
<i>Bastard</i>	283
<i>Beckwith's</i>	278
<i>Bersine</i>	273
<i>Birdsfoot</i>	175
<i>Bladder</i>	281
<i>Bokhara</i>	202
<i>Brazilian</i>	198
<i>Brown</i>	277, 294
<i>Buckhorn</i>	303

	No.
<i>Clover, Buffalo</i>	295
<i>Bur</i>	192, 195, 214, 217
<i>Burnett</i>	238
<i>Bush</i>	168
<i>Cabule</i>	202
<i>Californian</i>	195
<i>Carnation</i>	284
<i>Carolina</i>	279
<i>Cat</i>	276
<i>Cat-in</i>	176
<i>Chestnut brown</i>	299
<i>Chilean</i>	198
<i>Common</i>	284
<i>Cow</i>	288
<i>Creeping bush</i>	167
<i>Crimson</i>	284
<i>Dutch</i>	296
<i>Early</i>	288, 293
<i>Egyptian</i>	273, 284
<i>Elegant</i>	283
<i>Fall</i>	288
<i>Field</i>	272, 276
<i>Florida</i>	91, 248
<i>Foxtail</i>	298
<i>French</i>	198, 281
<i>German mammoth</i>	284
<i>Giant white</i>	283, 315
<i>Goat's</i>	115
<i>Gold-colored</i>	272
<i>Golden</i>	272, 280
<i>Gray</i>	276
<i>Hairy bush</i>	166
<i>Hard</i>	276
<i>Hare's</i>	276
<i>Hare's-foot</i>	276
<i>Heart</i>	217
<i>Honeysuckle</i>	296
<i>Hop</i>	272, 294
<i>Horned</i>	175
<i>Hungarian</i>	292
<i>Hybrid</i>	283
<i>Italian</i>	284
<i>Japan bush</i>	165
<i>Japan</i>	168
<i>June</i>	293
<i>King</i>	168
<i>King's</i>	206
<i>Large American</i>	288
<i>Large</i>	288
<i>Large golden</i>	272
<i>Large white</i>	202
<i>Lesser</i>	294
<i>Little yellow hop</i>	280
<i>Long-stalked</i>	286
<i>Low hop</i>	294

	No.		No.
Clover, <i>Lowland</i>	289	Clover, <i>Suckling</i>	280
Lucern	198	Sulphur	291
Maltese	125	Swamp-horn	179
Mammoth	288	Swedish	283
Mayad	300	Sweet	202
Meadow	288	Thread	280
Medick	192	Tree	202
Medium	288	trefoil	288
Medium red	293	Virginia bush	170
Melilot	206	Violet	169
Mexican	248	Wavy-stemmed	288
Mountain red	287	Welsh	276
Mouse	276	Western	282
Nevada	301	White	296
Peavine	288, 293	White crimson	284
Pennsylvania	295	Dutch	296
Perennial hybrid	283	prairie	141
red	288	Swedish	283
Pin	103, 104	Yellow	272, 290, 294
Plaster	206	hop	272
Pod	206	suckling	280
Prairie	141	sweet	204, 206
Purple	285	Zigzag	288
Purple bush	169	hare	288
prairie	141	Cocko bean	91
Rabbit foot	276	Comfrey	265
Red	293	Common buckwheat	108
Reddish	298	clover	284
Red goat	298	field bean	107
hare	298	melilot	206
perennial meadow	288	spike rush	96
top	293	wild vetch	310
Reversed	297	Conanthus	70
Round-headed bush	164	Congo pea	44
Round snail	196	Cotton bush	140
Running	299	purslane	236
Running buffalo	299	Cow clover	288
Sand	288	grass	288
Sapling	288	horn	303
Scarlet	284	Coupea	330
Shamrock	294	Crane's-bill	104, 113
Shopman's	168	Creeping bush clover	167
Slender	280	kidney bean	217
Slender-stalked	280	trifolium	296
Small-flowered	280	Crimson clover	284
red	293	Cultivated medicago	198
Smooth snail	197	Dakota vetch	174
Snail	197, 199, 201	Dal	44
Soiling	288	Dandelion	266
Soola	195	Deer brush	4
Southern	275	Deerweed	176
Spanish	248	Desmanthus	85
St. Mary's	195	Dogbane	17
Stone	276, 296	Dooryard grass	280
Strawberry	281	Downy-leaved Thermopsis	268

	No.		No.
Duckweed	230	Goat's rue	115
Dutch clover	296	Gold-colored clover	272
Dwarf broom-weed	122	Golden clover	272, 280
sedge	53	rod	262
Early clover	288, 293	Goober	18
dalea	82	Goosefoot	63
Earth nut	18	Gorse	304
Egyptian clover	273, 284	Gram	65
Elegant clover	283	Grant white clover	315
Elliott's sida	259	Gray bush	137
Endive	66	clover	276
Ephedra	99	saltbush	27
Esparcette	211	Greasewood	252
Everlasting bean	221	California	6
pea	152	Greek hay	303
Fall clover	288	Green gram	219
purslane	209	sage	39
tallow weed	11	Ground almond	77
False hellebore	308	nut	16
verbena	173	plum	23
Fenu-greek	303	Guar	75
Few-flowered beggarweed	90	Gunaninpil	7
Field clover	272, 276	Hagy	163
pea	225	Hairy bush clover	166
trifolium	276	vetch	329
Filaree	103, 104	Hall's rush	255
Filaria	103, 104	Hard clover	276
Fireweed	61, 101, 109	Hare clover	276
Five-finger	237	Haresfoot clover	276
Flag	131, 147	Hare's little paw	276
Flat pea	158	Heart clover	217
Fleshy lupine	187	Hedge vetch	325
Fleur-de-lis	131	Hognut	77
Florida beggarweed	91	Hog peanut	13
Florida clover	91, 248	trefoil	294
Fox clover	298	Honey locust	118
sedge	56	Honeysuckle	125, 296
Foxtail clover	298	clover	296
Franseria	111	grass	296
French clover	198, 284	Hoop koop	168
honeysuckle	125	Hop clover	272, 294
lucern	198	Horned clover	175
Furze	304	Horse bean	107
Garbanza	65	Horseshoe vetch	129
Garden pea	226	Horseweed	101
Garry's oak	244	Hottentot fig	207
German mammoth clover	284	Huajillo	227
Giant knotweed	234	Hungarian clover	292
sedge	46	melilot	205
spurrey	264	Hybrid clover	283
vetch	315	Idaho pea	65
white clover	283	Indian bean	220
Glasswort	250	hemp	17
Goat's clover	115	Ipecac weed	248
horn	303	Iris	131

	No.		No.
Italian clover.....	284	Medick clover.....	192
<i>Japan</i> clover.....	168	Medium clover.....	288
bush clover.....	165	red clover.....	293
Japanese buckwheat.....	108	Melilot clover.....	206
<i>Jesuit's tea</i>	242	<i>Mesquite bean</i>	239
<i>Jimsedge</i>	47	<i>Metcalfe bean</i>	222
Juno clover.....	283	<i>Mexican clover</i>	248
<i>Kidney clover</i>	168	Milfoil.....	3
grass.....	168	<i>Milk pea</i>	114
vetch.....	15	<i>Miller bean</i>	112
King's clover.....	206	<i>Modiola</i>	208
Kitten plant.....	276	<i>Montana bush pea</i>	269
<i>Knotweed</i>	230, 232	<i>Mountain mahogany</i>	60
Lamb's quarters.....	63	pea.....	268
tail.....	276	red clover.....	287
Large American clover.....	288	Mouse clover.....	276
clover.....	288	<i>Myrtle-leaved vetch</i>	148
golden clover.....	272	<i>Naked-flowered beggar weed</i>	88
white clover.....	202	<i>Narbonne vetch</i>	322
<i>Late-fruited sedge</i>	50	<i>Narrow-fruited sedge</i>	55
<i>Lavatera</i>	161	<i>Nelson's saltbush</i>	32
<i>Leafy beggar weed</i>	86	<i>Nevada clover</i>	301
prairie clover.....	141	<i>New Zealand spinach</i>	267
<i>Lentil</i>	105, 144	No-eye pea.....	44
tare.....	328	<i>Northern sweetweed</i>	124
vetch.....	328	<i>Nuttall's salt sage</i>	31
<i>Lesquerella</i>	171	<i>Old-man saltbush</i>	247
Lesser clover.....	294	<i>One-flowered vetch</i>	321
<i>Lippia</i>	172	<i>Oregon vetch</i>	150
Little yellow hop clover.....	280	Pea.....	225
Long moss.....	270	buffalo.....	187
<i>Long-stalked clover</i>	286	bush.....	269
<i>Louisiana vetch</i>	318	Canada field.....	225
Low hop clover.....	294	Congo.....	44
<i>Lowland clover</i>	289	everlasting.....	152
<i>Lucern</i>	198	field.....	225
clover.....	198	flat.....	158
medicago.....	198	garden.....	226
<i>Lupine</i>	183	meadow.....	154
fleshy.....	187	no-eye.....	44
sand.....	181	pigeon.....	44
scented yellow.....	184	Texas.....	24
white.....	180	winter flat.....	144
yellow.....	184	woodland.....	159
<i>Madder</i>	249	<i>Peabush</i>	258
Maltese clover.....	125	<i>Peanut</i>	18
Mammoth clover.....	288	Pea vine.....	150
Manured medick.....	198	clover.....	288, 293
<i>Many-leaved vetch</i>	153	Pennsylvania clover.....	295
<i>Mayad clover</i>	300	<i>Peppergrass</i>	162
Meadow clover.....	288	Perennial hybrid clover.....	283
pea.....	154	red clover.....	288
rush.....	253	Petsi.....	105
Medick.....	198	<i>Phasemy</i>	223
bur.....	192	<i>Pigeon pea</i>	44

	No.		No.
Pigeon weed	248	Salad burnett	238
Pigweed	10, 63	Saleratus weed	250
Pin clover	103, 104	Saltbush	120, 245
grass	103, 104	<i>annual</i>	28
Pinweed	103, 104	<i>arrow-leaf</i>	246
Pine grass	49	<i>Australian</i>	34
Plantain, woolly	228	<i>blue</i>	64
Plaster clover	206	<i>gray</i>	27
Pod clover	283	<i>Nelson's</i>	32
Pomme blanche	241	<i>old man</i>	247
<i>de prairies</i>	241	<i>round-leafed</i>	30
Poor toe	248	<i>scrub</i>	33
Prairie clover	141	<i>slender</i>	29
<i>sagebrush</i>	20	<i>Utah</i>	35
<i>turnip</i>	241	<i>woolly</i>	98
Prickly comfrey	265	Salt sage, Nuttalls	31
<i>pear</i>	212	<i>Spiny</i>	26
Pride of California	156	<i>Tumbling</i>	37
Purple bush clover	169	Samphire	250
<i>clover</i>	285	Sand clover	288
<i>medick</i>	198	<i>lupine</i>	181
<i>prairie clover</i>	141	<i>spurrey</i>	263
Purslane	235	<i>vetch</i>	329
Pusley	235	Saplin	288
Pussy-wort	276	Sapling clover	288
Rabbit foot clover	276	Scarlet clover	284
Ragweed	12	<i>vetch</i>	314
Rain tree	5	Scented yellow lupine	184
Ramie	40	<i>Scotch broom</i>	81
<i>grass</i>	40	<i>Scouring rush</i>	100
Rape	42	Screw bean	240
Rattlers	73	Scrub saltbush	33
Red clover	293	Sea club rush	256
Reddish clover	298	Seaside arrow grass	302
Red goat clover	298	Sedge	110
<i>hare clover</i>	298	Sensitive plant	233
<i>perennial meadow clover</i>	288	Serradella	213
Red-top clover	293	Seven seed	303
Reverse clover	297	Shad scale	25
Rib grass	229	Shamrock	296
<i>herb</i>	229	<i>clover</i>	294
Ripple grass	229	Sheeplick	121
River-club rush	254	Shepherd's purslane	14
Rolling pigweed	8	Shoe-string	243
Round-headed bush clover	164	Shopman's clover	168
<i>leaf saltbush</i>	30	Shouy vetch	151
<i>snail clover</i>	196	Silver-hulled buckwheat	108
Running buffalo clover	299	<i>-topped sedge</i>	51
<i>clover</i>	299	Silvery sage	19
Rusby's sedge	78	Slender bog rush	136
Russian melilot	203	<i>clover</i>	280
Sacaline	234	<i>saltbush</i>	29
Sachaline	234	<i>stalked clover</i>	280
Saghalin polygonum	234	Small-flowered clover	280
Sainfoin	211	Small-flowered vetch	320

	No.		No.
Small-flowered red clover.....	293	Tarweed.....	188
Smartweed.....	232	Tenfinger.....	186
Smooth snail clover.....	197	Texas beggarweed.....	89
milk pea.....	113	pea.....	24
Snail clover.....	199, 201	Thread clover.....	280
Sneezeweed.....	126	Three-flowered beggarweed.....	92
Soiling clover.....	258	Tick trefoil.....	91
Soja.....	119	Toothed medick.....	192
Soola clover.....	125	Tornillo.....	240
Southern clover.....	275	Tree clover.....	202
vetch.....	323	lucerne.....	191
Sotol.....	84	mallow.....	160
Soy bean.....	119	Tribulus.....	271
Spanish bayonet.....	333	Trigonel.....	303
clover.....	248	Tsama melon.....	68
moss.....	270	Tuberous spike rush.....	97
peanut.....	18	Tufted spike rush.....	95
sainfoin.....	125	Tule.....	79
trefoil.....	198	grass.....	79
Spiny salt sage.....	26	Tumbleweed.....	8
sida.....	260	Tumbling salt sage.....	37
Spotted medick.....	195	Upright knotweed.....	231
Spring vetch.....	324	sedge.....	52
Spurred butterfly pea.....	58	Utah saltbush.....	35
Spurrey.....	263	Valerian.....	306
Square pod pea.....	178	Vancouveria.....	307
Star thistle.....	57	Velvet bean.....	210
Starch bean.....	224	Vetch, Alaska.....	326
Stickseed.....	94	American.....	310
Stinging nettle.....	305	biennial.....	311
St. John's bread.....	59	big-rooted.....	146
St. Mary's clover.....	195	big-seeded.....	319
Stolley vetch.....	317	black bitter.....	313
Stone clover.....	276, 296	chicken.....	312
Stork's bill.....	117	common wild.....	310
Storksbill.....	103, 104	Dakota.....	174
Straight bean.....	107	giant.....	315
Strawberry clover.....	281	hairy.....	329
headed trefoil.....	281	hedge.....	325
Straw sedge.....	54	horseshoe.....	129
Suckling clover.....	280	kidney.....	15
Sulla.....	125	lentil.....	328
Sulphur clover.....	291	Louisiana.....	318
vetch.....	157	myrtle-leaved.....	148
Sunflower.....	127	Narbonne.....	322
Sunn-hemp.....	72	one-flowered.....	321
Swamp-horn.....	179	Oregon.....	150
Swedish clover.....	283	sand.....	329
Sweet cassava.....	189	scarlet.....	314
clover.....	202	small-flowered.....	320
potato.....	71	Southern.....	323
trefoil.....	175	spring.....	324
Tagosaste.....	80	Stolley.....	317
Tallow weed.....	3	sulphur.....	157
Tanweed.....	232	wild.....	316

	No.		No.
<i>Vetch, winter</i>	145	<i>Winter fat</i>	106
<i>wood</i>	327	<i>flat pea</i>	144
<i>yellow</i>	149	<i>lentil</i>	105
<i>Virginia bush-clover</i>	170	<i>purslane</i>	105, 309
<i>Violet clover</i>	169	<i>vetch</i>	145
<i>Water grass</i>	48	<i>Wire grass</i>	133
<i>lentil</i>	114	<i>Wood rush</i>	132
<i>parsley</i>	248	<i>vetch</i>	327
<i>Wavy-stemmed clover</i>	288	<i>Woodland pea</i>	159
<i>Welsh clover</i>	276	<i>Woolly-joint</i>	102
<i>West Indian honeysuckle</i>	91, 304	<i>plantain</i>	228
<i>Western clover</i>	282	<i>saltbush</i>	98
<i>Whin</i>	304	<i>Xanthisma</i>	331
<i>White clover</i>	296	<i>Yam</i>	93
<i>crimson clover</i>	284	<i>bean</i>	214
<i>Dutch clover</i>	296	<i>Yarrow</i>	2
<i>lupine</i>	180	<i>Yellow clover</i>	272, 290, 294
<i>mustard</i>	293	<i>hop clover</i>	272
<i>prairie clover</i>	141	<i>larkspur</i>	45
<i>sage</i>	21, 74	<i>lotus</i>	177
<i>Swedish clover</i>	283	<i>lucern</i>	193
<i>trefoil</i>	296, 330	<i>lupine</i>	184
<i>Wild bean</i>	218	<i>meadow trefoil</i>	272
<i>Indian corn</i>	344	<i>moon trefoil</i>	193
<i>kidney bean</i>	221	<i>suckling clover</i>	280
<i>laburnum</i>	206	<i>sweet clover</i>	204, 206
<i>lettuce</i>	142	<i>trefoil</i>	175, 328
<i>tansy</i>	3	<i>vetch</i>	149
<i>vetch</i>	316	<i>Zigzag clover</i>	288
<i>Willow</i>	251	<i>hare clover</i>	288